(Established 1832).

AMERICAN ENGINEER AND RAILROAD JOURNAL.

PUBLISHED MONTHLY

BY

R. M. VAN ARSDALE

140 NASSAU STREET, NEW YORK

J. S. BONSALL,
Business Manager.

R. V. WRIGHT, E. A. AVERILL, } Editors.

OCTOBER, 1908

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CONTENTS

	PAGE
Care of Boilers at Terminals. By J. F. Whiteford	373*
Railroads and Prosperity	376
Effect of Water Soaking Timber	376
Welding Locomotive Frames. By A. W. McCaslin	377*
Locomotive Repair Costs per Mile	377
Experience as a Teacher	377
The Dynamics of Locomotive Machinery. By "G. E."	378*
Standard Location of Third Rail	382*
Longitudinal vs. Transverse Erecting Shops	382
Second Annual Conference of the Apprentice Instructors—New York Central Lines	383*
A Talk to Shop Superintendents and General Foremen. By Robert Quayle	390
Waste of Locomotive Fuel	391
Frame Breakages	392
Boiler Maintenance	392
Apprentice Instructors' Conference	392
Organization	393
Report on Condition of Power	393
Maintenance of Locomotive Tool Equipment. By Robert H. Rogers.	394
Qualifications and Duties of a Traveling Engineer. By W. L. Kellogg	396
Malleable Iron, Physical Characteristics of	397
Pacific Type Locomotive With Narrow Fire Box, C. & A. R. R.	399*
Forced Feed Lubrication for Axle Boxes	401
Steel Car Construction and Maintenance. G. E. Carson	402
Cables of the Manhattan Bridge	403
Heavy Gap Lathe	404*
Association of Car Lighting Officers	404
Magnitude of the Baggage Department	404
The Engineer and His Work	404
15-Inch Single Geared Crank Shaper	405*
Mechanical Draftsmen Wanted	405
Railway Signal Association	405
18-Inch Cone Head Engine Lathe	406*
Railroad Repair Shop Arrangement	406
Locomotive Axle Lathe	407*
Electricity and Agriculture	407
Railroad Club Doings	408
Evening Courses at Columbia University	409
Suggestions for Improving Method of Billing for Car Repairs	409
Hackett High Speed Drill	410*
Burning Shavings in Power Houses	410
Personals	411
Books	411
Catalogs	411
Business Notes	412

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An investigation of this kind will be found equally useful for the solution of other important problems; the perfection of the counter balances and the effects of steam distribution may be studied graphically, and the locomotive designer is enabled to more intelligently design the rods and guides, the bolting of the cylinders and boilers to the frame, etc.

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When the apprentice department was organized it was with the idea that the practical results which would accrue to the company would not appear for several years, or at least not until sufficient time had elapsed to graduate thoroughly trained apprentices. It must give those officers who were responsible for the installation of the department, and who had so great faith in its future possibilities, considerable gratification to see the practical benefits which have thus far appeared, although the system has been in operation less than three years. Another feature which cannot be viewed but with satisfaction is the interest which the boys themselves have taken in the development of this work and the ready response which the efforts of the company have met with on every side. The installation and carrying on of this work on the New York Central Lines must

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have cost considerable and yet it is doubtful if the same amount of money expended in any other way could produce so great results if we consider only those benefits now apparent and leave out of consideration the very much greater advantages which will surely result in the future.

ORGANIZATION.

A number of years ago a superintendent of motive power of one of the larger systems was severely criticized for adding to his organization a number of so-called specialists, each one of whom was detailed to make a special study of and give general supervision to a certain part of the work, such for instance, as boiler work, roundhouses, fuel economy, etc. During recent years a few roads have taken up this idea to a greater or less extent, but in most cases it is not being used nearly as effectively as it might be.

It seems to be generally acknowledged that there are very great possibilities of saving in the matter of locomotive fuel, and yet how few roads are making any systematic attempt to follow this matter up. In several instances attention has been focused on one or two phases of the fuel question, and while good results have been obtained, yet the really big savings are not made, because in most cases no one person is responsible for following up and supervising this work. The general officers of the department are ordinarily burdened with so many routine duties as not to admit of their making more than spasmodic efforts to secure these economies. As a matter of fact, there are only a very few roads having a man in charge of the fuel question who makes it his business to follow the coal from the time it is mined until it is used in the locomotive. The fuel question is here used only as an illustration. There are a number of other features in the motive power department which require the same treatment. The roads have grown so fast that they have hardly had time to adapt their organization to meet the larger problems which have developed, but surely it is time to do so.

A. M. Waitt, in an article on "Some Thoughts and Suggestions on Railroad Organization and Management," which appeared in the *Railroad Gazette*, March 11, 1904, had this to say: "In railroad organization, for large systems, more of the military type of organization is needed, both in the way of a general staff for assisting the chief executive officer and also a corresponding departmental staff for the assistance of the department chief." In a brief summary at the end of his article Mr. Waitt mentions a dozen or more items which are necessary in an efficient organization, one of which is as follows: "Chief executive officers and department chiefs to have a sufficient staff of able men to relieve them from routine and detailed work, and also to have a corps of assistants who are free from confining routine work who can be assigned to special investigation of important matters in department work."

Harrington Emerson, in one of a series of articles on "Efficiency as a Basis for Operation," in the September issue of the *Engineering Magazine*, draws attention to the strength and weakness of existing systems of organization. In general these are of two distinct types, line or staff, or a combination of the two. The line may be illustrated by the earlier methods of army organization, before the general staff was added. Some one was always ready to assume the command no matter how many of the men or officers may have been destroyed. Such an organization is practically indestructible. The objection to it was that the promotion was strictly by seniority and not by merit, and no one officer knew much more than the others. It was the addition of the staff to the line which enabled the Prussian army under Von Moltke to overthrow the combined armies of Austria and Southern Germany in an exceedingly short campaign, thus making possible a united German kingdom, which in turn defeated the French in a campaign of less than two months.

In the staff organization the men who are specially well equipped and adapted for certain lines of work are selected and placed in charge of that work. With their superior knowledge they are enabled to secure the best solution to the problems which are referred to them and, where the staff is used in combination with the line, their findings are turned over to and put into effect by the line organization. Mr. Emerson's idea is that the best results are secured by a combination of these two types of organization, the two branches working as much as possible in parallel. In this way the lowest paid workman in a large organization will have the benefit of the special knowledge of a staff of experts.

The problem of efficient organization is the most important one which at present confronts not only the motive power department, but all departments of the railroad. A paper on this subject which is to be presented by J. E. Muhlfeld, before the New York Railroad Club at one of the winter meetings, will be awaited with interest.

REPORTS ON CONDITION OF POWER.

At a conference of motive power officials on a large system a rather spicy discussion recently took place as to reports on the condition of power. A mathematical analysis of some of the statements which were made showed that they were simply ridiculous. The discussion prompted one of the officials to send us the following notes:

"Engine condition is commonly reported as good, fair, and poor. The definition of these terms is usually as follows:

"Good engines are those whose condition is such that they can run for six months or more before shopping.

"Poor engines are those whose condition is such that they must be shopped in one month or less.

"Fair engines are those that are neither good nor poor.

"Assume that engines are in service twelve months or one year between shoppings, and that the time required for shopping is thirty days, or one month. The future record of an engine just out of the shop should then be:

"For the first six months, good; for the next five months, fair, and for the next month, poor. This accounts for twelve months, and according to the first assumption of twelve months between shoppings, the engine should now be ready for shop. At the end of thirty days the engine should again come out of the shop and the same cycle be repeated. Thirteen months makes the complete cycle.

"The ideal state of affairs exists as to condition when engines are coming to the shop in a steady, constant flow from month to month. This is much better than a spasmodic shopping of five per cent. one month and twenty-five the next, which is not uncommon.

"Returning again to the assumption of twelve months between shoppings and one month per shopping and assume also a division having a total of 130 engines. Ideal conditions then would be at any date:—

10	engines	in	shop	= 7.7%
10	"	"	poor condition	= 7.7%
50	"	"	fair "	= 38.5%
60	"	"	good "	= 46.1%

"We thus have a check on the per cent. of engines that should be in the various grades of condition. Any report which shows over 46.1 per cent. of the power in good condition, and yet shows the per cent. of engines shopped from month to month to be averaging from seven to ten per cent. is a fudged statement.

"Twelve months between shoppings is none too small a record for many roads. Yet roads making this average are trying to have master mechanics keep from sixty-five to seventy per cent. of their power in good shape. This is proven above to be an impossibility. The only way to accomplish it is to change the definition of "good," or else get more months service between shoppings.

"If the months between shoppings be increased to eighteen, the other assumptions remaining the same, the ideal conditions on a division would be:—

5.3%	in	shop.	
5.3%	"	poor	condition.
26.3%	"	fair	"
63.1%	"	good	"

MAINTENANCE OF LOCOMOTIVE TOOL EQUIPMENT.

By Robert H. Rogers.

One of the most vexatious problems for motive power management in general is that of keeping the tool equipment of locomotives to the required standard. The term equipment is flexible; on many roads it applies only to small tools, oil cans, etc., which the engineer may or may not require for use on the trip, while in other instances it may be taken to mean everything "loose" on the engine. No matter, however, what may be the interpretation it is usually a source of considerable trouble, to say nothing of a comparatively large and, in many instances, an unwarranted yearly expenditure.

When a new or a repaired locomotive is placed in service it is equipped with the tools called for in the company's specification, a copy of which is often framed and secured in the cab. The equipment is distributed in different boxes, one or more of which may be sealed, as they contain tools only for emergency use, and the others provided with locks, the keys being in the custody of the engineer for the trip. On all roads instructions regarding the manner in which the equipment shall be handled and accounted for in the case of loss or damage, are couched in such unmistakable wording that there would seem little room for confusion or evasion; but actually the practice becomes the antithesis of all carefully builded plans.

It is a fact beyond dispute that on a very large proportion, probably over one-half of the locomotives in use in this country, scarcely a single tool remains in the boxes after six months' service, even admitting that the engine in question is handled by a regular crew. In the case of a pooled engine, few remain after six weeks. There may be one or more screw jacks, with galled threads, and a dilapidated wrecking frog or so on top of the tank, but all locks, hasps, seals and even hinges have long since disappeared from the boxes. If the latter contain anything at all, the inventory may reveal a broken flat chisel and a sprung monkey wrench without a handle, this wrench also performing the office of a hammer when needed. Such conditions, of course, do not apply to all roads, as many of them do well in maintaining their equipment, but on many others they fit to a nicety.

This deplorable state of affairs has a much further reaching influence than may become apparent at first thought. The tools named in the specification represent a carefully considered selection of what is required to meet any ordinary emergency. If the assortment is complete, the engineer, in the event of a breakdown, may effect temporary repairs and proceed in a few minutes, whereas an hour may be lost if the equipment is short. Instances are innumerable where exaggerated road delays may be traced directly to such a deficiency.

Not long ago, on an Eastern railroad, an engine lost the nuts off one of the crosshead pins. With the proper wrench, or even a hammer, the engineer could have removed the jam nut from the pin on the other side and continued his trip with one nut on each pin. It so happened that no tools of any description were available and a long delay ensued, involving also a limited, extra fare, train. A number of instances are recorded where an air pipe has broken off at some union due to vibration and the engineer has been unable to make use of the thread remaining on the broken pipe as he had no means of screwing it into the union. The master mechanic, in such cases, cannot justly censure the engineer for failure to take advantage of the situation, and the engineer knows it. In consequence he may become indifferent generally to the supreme importance of getting his train moving as soon as possible after a slight breakdown.

These facts are, of course, well known to all motive power men. It is quite a rarity in reading the stenographic notes of an inquiry into a serious engine failure, not to find the engineer quoted somewhere with this remark: "I wouldn't have been there so long if I had anything to work with," and altogether too often his excuse is well taken.

The situation has indeed become so bad, that even with the thoroughness of these days in the handling of all details of railway management, it has apparently been abandoned by many motive power chiefs as a problem hopeless of solution. The amount charged directly to maintenance of locomotive tool equipment has grown into such proportions that more than one road refuses to recognize or evades the proper charge in a manner which serves to wipe the account out altogether.

The explanations of the enginemen to account for the loss and the reasons for renewal are varied to a degree. It has been said that the engineers do not take proper care of the tools; that they fail to lock the boxes on arrival at the other end of the division, and the tools are stolen while the engine is at that end. The fireman is said to throw his shovel away after the first trimming of the edge by the blacksmith, and also the fire hook when it becomes burned or needs repairs. Any case of shortage is, of course, always investigated, but such investigations as a rule are superficial and do not reach the seat of the trouble.

It is not impossible to handle this trying proposition. The problem of keeping tools on the engines can be resolved into a simple, if not a pleasant, matter in its details if inaugurated on the proper basis and intelligently handled thereafter.

The principal items for consideration should be as follows:

(1) Simplify the existing equipment.

(2) Be sure that each new engine, or each repaired engine is put into service with each item of equipment.

(3) Have the equipment thoroughly checked previous to each departure from the home terminal.

(4) Insist on the co-operation of the division points at which the engine turns.

(5) Have a check on the entire procedure, and make each delinquency a matter of record.

(6) Impose discipline for violation of rules necessary to preserve the tool system, as would be done in the instance of other recognized rules.

Simplifying the equipment is naturally the primary step. This should be taken to mean the elimination of superfluous items, and so far as possible have one item perform the work of two or more. For instance, confine the item of monkey wrenches to one 18 in. monkey wrench, cut out the crank pin block on engines which have a collar on the main pin, clamp the valve stem clamp on the stem and let it ride there until needed. Many other points of a like nature will suggest themselves when the matter is thoroughly gone into. It is a requisite for a satisfactory working of the system that, when the different items are finally decided upon, each engine should receive full equipment. If an item or two is missing it is preferable to postpone the inauguration of the system until everything is on hand.

Intelligent tool checking is one of the bulwarks of any system and a special man should be used for this purpose. With the engines once equipped and the various items in the boxes assigned to them under the framed specification, it is possible for one man to check one hundred engines per day. It is not necessary, of course, to disturb the sealed boxes. The checker's report of the engine should be a matter of record. All newly equipped engines will, of course, be "O. K." on his report, and the general record will commence with the first trip.

Co-operation with division points may be illustrated by the following example. Engine 508 leaves its home terminal, for a trip, with equipment certified to by checker as "O. K." The storekeepers at all turn-around points have been instructed by the master mechanic to wire the division headquarters if any material is drawn from their storehouses by one of his engineers. The storekeeper, however, is not to refuse the order. Engineer Brown, of engine 508, draws one fire hook at a turn-

around storehouse, also one 18 in. monkey wrench, and the fact is known at the terminal before he returns.

He accordingly finds the following form in his letter-box when he does reach the home terminal:

ROME & PARIS RAILROAD CO.

Rome Mar. 14 1908.

Mr. John Brown engineer, train No. Extra engine 598

Dear Sir:-

I am advised that on your last trip East you drew from the storeroom at Paris the following items of locomotive tool equipment:

One (1) fire hook.
One (1) 18" Monkey wrench

Please advise promptly, using ruled space on this form below, necessity for above action, your tool equipment having been checked as correct previous to your last departure from Rome.

Yours truly,
Richard Roe
M. M.

Reply to above:- When fireman Smith went to throw fire hook on top of tank it fell off at Melling Junction. In regard to monkey wrench I had to draw one in Paris to change as it was gone when I started to get engine ready. I locked tool boxes and went to supper and when I returned the box was broken open and wrench stolen John Brown
Engineer.

Date 3/15/08

It is, of course, up to Brown to make some explanation on this form, which will be followed with the same care characteristic of all railroad correspondence, and no matter what he may say a clew is at once afforded for a satisfactory handling of the matter. In this illustration the master mechanic or foreman at Paris would be promptly advised that the Rome engines were having their boxes broken open at his terminal, citing a specific case in point and fireman Smith would no doubt be censured or disciplined for carelessness resulting in the loss of the fire hook.

The possibilities of this form are infinite, but it should be borne prominently in mind that its usefulness cannot be fully demonstrated unless the engine in question is completely equipped before leaving the home terminal. It is indeed astonishing and gratifying to note the results which can be quickly brought about by adhering to this general plan as outlined. Through it the author in less than three months straightened out the most unsatisfactory situation possible to imagine, with pooled engines and practically no equipment to start with. It effectually eliminated the engine crews from consideration in regard to loss or damage of tools and narrowed the inquiry to the points between which the engine ran, at the same time often affording a positive clew to determine who was at fault in connection with those terminals.

On arrival at his home terminal the engineer should deliver the keys of his boxes to the engine dispatcher or roundhouse foreman, who will hang them on a board in his office where they may be under constant observation and cannot be taken from their hook without his permission. In other than the home terminal, especially if a turn-around point, the engineer after carefully locking the boxes should retain the keys, this, of course, on the presumption, which is usually a fact in practice, that he will return with his own engine. A thorough checking of the equipment at the home terminal should suffice, and this should not be necessary at the turn-around or other end of the division.

This simple plan may be adapted to any railroad and developed to meet the requirements of any volume of traffic. The knowledge on the part of the employees that the tool question is being closely followed up by the management never fails to result in a permanent improvement.

* * * * * * *

[EDITOR'S NOTE: *This subject was discussed at the last convention of the Railway Storekeepers' Association and several valuable suggestions were made by members presenting papers on it. Abstracts from two of these are given below.*]

BY A. T. SEXTON.

Economy in the use of tools and supplies entrusted to locomotive and train crews is an important matter confronting railway managements of the present day.

This subject has been very ably presented in some recent articles by Mr. E. Fish Ensie.*

Notwithstanding all the precautions on the part of the management, those engaged in train service regard tools and supplies in a large measure as common property, appropriating whatever may best suit their convenience from one equipment to another, or from supplies in transit. This tends to mar the efficiency of the train service, as some crews are over-provided with supplies while others are markedly deficient.

Numerous instances arise where scrap brasses and defective air-hose are left on the right-of-way after applying new ones; also tools, frogs and switch ropes are often left after being used.

To obviate these conditions and care for the necessary requirements with efficiency and judicious economy, I would suggest that the practice of locomotive and train crews drawing tools and supplies, be entirely abolished; that a responsible person of intelligence and good judgment be stationed at all large terminals, for each department, clothed with authority to check up the locomotive and caboose equipments with the audit sheets, hereinafter described, after each round trip—switch engines each day during the noon hour—supplying and properly charging any articles that may be deficient. At the smaller points this duty could be performed by the car, roundhouse foreman, or any other person whose duties would admit of it. At the large terminals, the person entrusted with these duties would carry a petty stock of emergency supplies. An emergency slip should be provided for supplies drawn en route and a record sent the checker in charge of the supplies at the home of the engine.

In this connection a printed list of the items, constituting an equipment and approved by the management, should be provided in duplicate for each locomotive, caboose and passenger train box or locker, the duplicate list to be held by the person having supervision over the checking and issuing of supplies for the department in question.

The audit sheets would provide columns for:

1.—The items constituting an equipment.
2.—Tools on hand the first of the month, and their value.
3.—Tools drawn during the month, showing day and date.
4.—Total of tools drawn during the month, and their value.
5.—A daily register of the crew in charge.

Under this plan fifteen minutes or less would be required to check the supplies of an engine, ten minutes for a caboose.

I maintain by instituting a system of this description a marked saving can be had over and above the additional cost of checking and furnishing the tools and supplies.

Delays in the departure of trains incident to crews drawing equipment at the last moment would be eliminated.

Tools admitting of repair would receive prompt attention and a high standard of efficiency in the train service would be attained at a minimum expense.

Employees would enter upon their duties with greater assurance, knowing they were in possession of the necessary tools and supplies in good order, thereby diminishing wrecks and protecting life and property.

The audit sheet in this compact form would afford valuable information for the management at all times, open the way for commendation to the frugal locomotive and train crews, and

* See AMERICAN ENGINEER, 1908, January issue, page 7, and March issue, page 90. See also AMERICAN ENGINEER, 1905, November issue, page 412.

bring into the lime light those not acquainted with the definition of economy.

By C. L. Warner.

The greatest difficulty to overcome in the effort to effect proper use and care of tools and supplies we find is, primarily, lack of knowledge of the value of the materials upon the part of the employee in whose hands the materials are placed, with the consequent carelessness in their use and protection, and the difficulty of definitely locating responsibility for waste.

The most simple, inexpensive and effective plan or system that has come under my observation for checking tools and supplies issued from stock, and the caring thereof is herewith set forth:

First: A suitable building should be furnished at terminals, properly fitted with shelving, for caring of engineers' tool boxes, hooks placed in the ceiling and side walls for hanging thereon lanterns and scoop shovels. Blue print herewith showing interior arrangement of shelves and hooks. The oil house could be arranged and readily adapted for this purpose, provided it is spacious.

Second: Each individual engineer should be provided with a tool box, his name printed thereon, made preferably of No. 24 galvanized iron, outside dimensions of box 19⅞ inches by 5⅛ inches, top to be in one piece, bottom in one piece, double seamed with the edges turned to sides, side made in one piece with edges turned, double seam, No. 8 wire used on wired edge of box, all other wired edges made of No. 10 wire, four 5-lb. rivets in handle, all other rivets to be 3-lb. In this box can be placed the tools required on a locomotive.

Third: Upon arrival of engine at terminal the tool box and loose tools about the engine, such as jacks, brooms and lanterns should be removed and taken to the storage building for necessary check and ascertaining if the full equipment required is intact. The first important feature for a systematic check on engine supplies is to see that the engineer is fully equipped with necessary tools and supplies as prescribed by the rules of the Operating Department, a complete individual record made, showing the date supplied, so that ready reference may be obtained at any time. This individual record should show, at all times, all tools and supplies excepting oils, waste and fuel furnished the engineman, the date supplied, why necessary, whether account loss, breakage or worn out. If on account of the latter two named causes, the worn out or broken tool must be returned in exchange and the records show accordingly. If the tool is lost, the tool checker must make prompt report through the channel desired to reach the official under whose supervision the engineman comes, so that proper discipline can be exercised. The tool checker should be advised through the proper channel the action taken in the premises to enable him to make record. In addition to keeping this individual record, a monthly report should be made to all the officials concerned, showing the name of the persons receiving any tools during the current month, the date supplied, the value and why necessary, and whether or not the old tool was returned in exchange. Such reports, issued monthly, should assist much in bringing about the maximum saving in this item of operating expense. Make this tool and supply question a personal affair between the company and employee.

Fourth: One of the most important necessities in having a systematic check on engine tools and supplies is a competent, determined, thoroughly reliable tool checker. Such a man should be well paid, and have full authority in order to bring about economical results. A person qualified, looking after this item of expense, will fully reimburse the railroad by the saving he will be enabled to attain. These tool checkers should be furnished with the necessary assistance for removing the tools and supplies from the engine upon arrival at terminal and the return of same to the engineman when he is ready for the next trip over the division. The duties of the tool checker should be to check the tools after they are brought to the storage building, see that they are properly placed in storage and that the full equipment be returned to the engineman when he is ready for the next trip—tool checkers to personally keep the individual record.

In conjunction with this system of checking supplies issued with a view of having an accurate and honest record made, it is very necessary that your oil house man be efficient and trustworthy.

To summarize: First, have a thoroughly organized and efficient corps of reliable tool checkers and oil house men.

Second: Inaugurate systematic schedules, records and reports and follow them up continually, locating careless employees.

Third: Insist upon having each engineman or conductor keep a full complement of tools as prescribed by the rules of the company, holding them responsible for neglect to do so at any time.

The procedure outlined above, if adopted, should result advantageously and bring about the economical uses of tools and supplies.

QUALIFICATIONS AND DUTIES OF THE TRAVELING ENGINEER.*

By W. L. Kellogg.

The traveling engineer must have knowledge and the faculty of imparting it. He must have convictions and courage to prosecute them. He must have no friends, and need have but few foes. He must be energetic and still maintain a couple of suits of overclothes. He must in all cases be able and willing to set the example of his precepts. He should learn early in his career that he is not employed to make excuses for men who were cut out for some other vocation besides railroading. He should be an expert, smooth and careful runner. He should be an authority on breakdowns and the mooted mysteries of the compound engine, the new valve gear and the setting of the old, the cause of brake failures and the way to prevent them. He must know the cost of materials and supplies and the best way to secure their economical use. He must be a fuel expert, a good judge of water and leave all opinions of other liquids to the politicians. In short, he should have few less requirements in his makeup than Carlton prescribes for an editor. So much for the man and a few of his multitudinous qualifications.

The instructions to the traveling engineer should be explicit, yet broad enough to meet all emergencies. He should be instructed to frame and guide sentiment, to look after and coach the firemen who are to make the future engineers. He should be instructed to look after the comfort of engineers and firemen on the road and at way terminals, so that a good and harmonious feeling will always be maintained. He should report meritorious conduct as well as the derelict and let the higher official take due action in rewarding proficiency, as well as punishing culpability thus reported.

To attempt to standardize his duties would in our estimation be a mistake. He should be considered as an assistant to the head that appoints him, which head usually knows its own weaknesses, and the duties assigned should be such as the next higher in authority cannot from lack of training or inclination properly attend to, and in this way balance the strength of the organization. There should, however, be some assigned duties. There is no more logic in allowing a traveling engineer to work at random than any other official or semi-official, yet he should not be so tied down that he has no opportunity to display his own peculiar abilities. The keynote of the answer will be found in the question itself if you will underscore the words "make himself." We are all what we make ourselves, not what others make us, and to a man given the range and latitude that usually falls to a traveling engineer the opportunity to make himself is always present.

As tutor and disciplinarian of engineers he should remember that we were all born innocent and have to learn; that to make a man is a great credit, to break one can only be justified as a painful duty. He should bear with the plodding yet safe man, yet remember it is an equal charity to rid the service of a dan-

* From an address before the Detroit Convention of the Traveling Engineers' Association.

gerous one. As an inspector of equipment and work he should early learn that which any official should know, namely, he cannot do it all himself, and his value will depend on his ability to command the co-operation of enginemen in seeing and reporting the defects that he would see if he were always there, and their insisting on the work being done for them as he would insist on it being done for him.

His mechanical training should have taught him the value of lubrication as an aid in the application of power and he should draw a close parallel between power as concerns energy and power as concerns authority. Nothing moves without applied power. Well lubricated machines or bodies move with minimum resistance. Friction in the machinery or friction among the men is often the result of power misapplied. An additional notch in the quadrant will force more steam through the cylinders and sometimes get you over the hill, just as you can force a man to do an unpleasant duty, but in an indifferent manner. If a few additional drops of oil through the lubricator or a few pleasantly spoken words will accomplish the same results you will have saved coal and machinery or the good will of a man, and the "esprit de corps" is the cream of an organization.

The science of railroading is the art of making things go smoothly, economically and on time. Nothing succeeds at haphazard. Select a man who is qualified to perform the peculiar duties that the service may stand in need of; assign him work that will take a reasonable percentage of his time to accomplish; systematize this portion of his work, but leave him some opportunity to develop along his own lines; vest him with all the authority needed; require brief yet complete reports of his work; insist on absolute loyalty to the company, but do not require him to be a "special agent."

Officials would do well to send their traveling engineers out occasionally on other lines to make observations, and if one is unable to absorb some good ideas from the poorest managed piece of railroad in the world, he is incompetent. Not one of us must get the idea that our road is perfect, or even the best, and the best will never be good enough. We must gather it in by observation, talking, arguing and reading a portion at least of the great mass of available knowledge as published by our mechanical papers.

A traveling engineer should make tests and be able at all times to give an intelligent reply to his superior on mechanical appliances such as injectors, lubricators, pops, brakes, etc.; also on materials, brasses, white metal, jacket iron and brake shoes. He should be able to furnish data and make intelligent argument in favor of, or against, engines, cars, wrecking appliances and the various component parts when his company is in the market for such equipment or parts. He should be called in consultation and be able to suggest the necessary changes from his notebook to make each time card a better time card. He should be an assistant, not a "knocker." If he spends his time telling what he would do were he master mechanic or superintendent of motive power, the chances are he will never be able to reach the point where a demonstration will be possible, although if his selection was made on merit and his ambition rightly directed there is no reason why he should not obtain one of these positions.

The traveling engineer should be in comparison like a huge sponge, able to absorb all he comes in contact with. If he cannot learn from the humblest wiper or truck builder, or the various classes with whom he has to deal he has mistaken his calling. These items of detail he must gather and segregate and compare until he is able to say this or that is the best method of practice. The traveling enginer should make indicator, fuel and other tests and report to the master mechanic, who usually accepts them without verification. He must be a close observer and take a live interest in economy; be an organizer, keep his men happy and properly keyed up to the requirements. He should be a believer in recognition as well as reward for good service rendered.

Let us dwell for a moment on the necessity of mental labor by our younger employees which must be stimulated and rightly directed. We often find young men willing workers in physical lines who are mentally paralyzed and who never read of the exploits, experiments and perplexing problems which have been worked out by past generations, the results of which should be in his library and much of it in his mind. The traveling engineer has the opportunity to enforce this mental culture.

The traveling engineer should take up the matter of waste—unnecessary popping, engines blowing and all things in general, and be able to illustrate its cost in the aggregate. The traveling engineer, above all other things, should preach and talk caution. His motto should be: "Better behind time at a terminal than ahead of time into eternity." These are days of high speed, probably in all walks of life. It is both expensive and dangerous. Much has been said and written along the above lines and the handling of locomotives drawing our friends and families, but the greatest advancement must come through the medium of that personal interest that every engineman and officer must have if he is desirous of increasing his ability and sphere of usefulness. If men are not thus inclined, they should be weeded out early in the game. Some few men have less judgment than the ordinary cow. You will know them because their chief interest centers on reaching terminals and pay day. If the traveling engineer finds them and weeds them out, he will have at least accomplished the much desired end of having a good personnel.

MALLEABLE IRON—PHYSICAL CHARACTERISTICS.

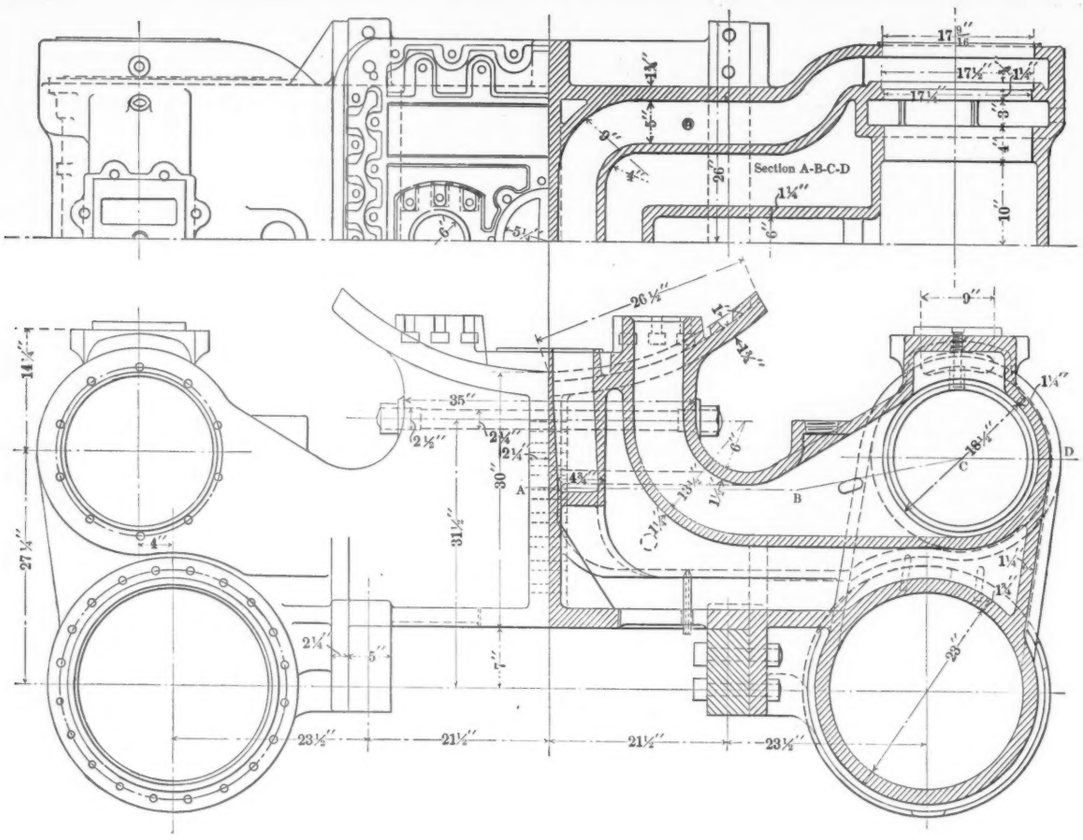
The physical characteristic that gives malleable iron its greatest value, and wherein it differs from gray iron, lies in its ability to resist shocks and an increased tensile strength. The degree of malleability in light and heavy castings varies. In a light casting ¼ in. thick and less, it means a soft, pliable condition and the ability to withstand considerable distortion without fracture, while in the heavy sections, ½ in. and over, it means the ability to resist shocks without bending or breaking.

The tensile strength of malleable iron varies with the thickness of the metal, the lighter sections having a greater strength per square inch than the heavier sections. This fact is now being recognized by engineers and at least one Eastern railroad, which requires its malleable castings made in accordance with specifications, designates the tensile strength desired in its castings to be as follows: Sections ⅜ in. thick or less should have a tensile strength of not less than 40,000 lb. per square inch; those of ⅜ to ¾ in. thick, not less than 38,000 lbs. per square inch, and those over ¾ in. not less than 36,000 lbs. per square inch. In recent tests along these lines, test bars ⅝ and ⅞ in. diameter were made in the same mold and poured from the same ladle, thus insuring equality of metal, and annealed together. The average tensile strength of five pairs of bars so treated, representing five heats, was: ⅝ in. bars, 45,095 lbs. per square inch; ⅞ in. bars, 41,316 lbs. per square inch. Average elongation in 6 in.: ⅝ in. bars, 5 3/10 per cent.; ⅞ in. bars, 4 2/10 per cent.

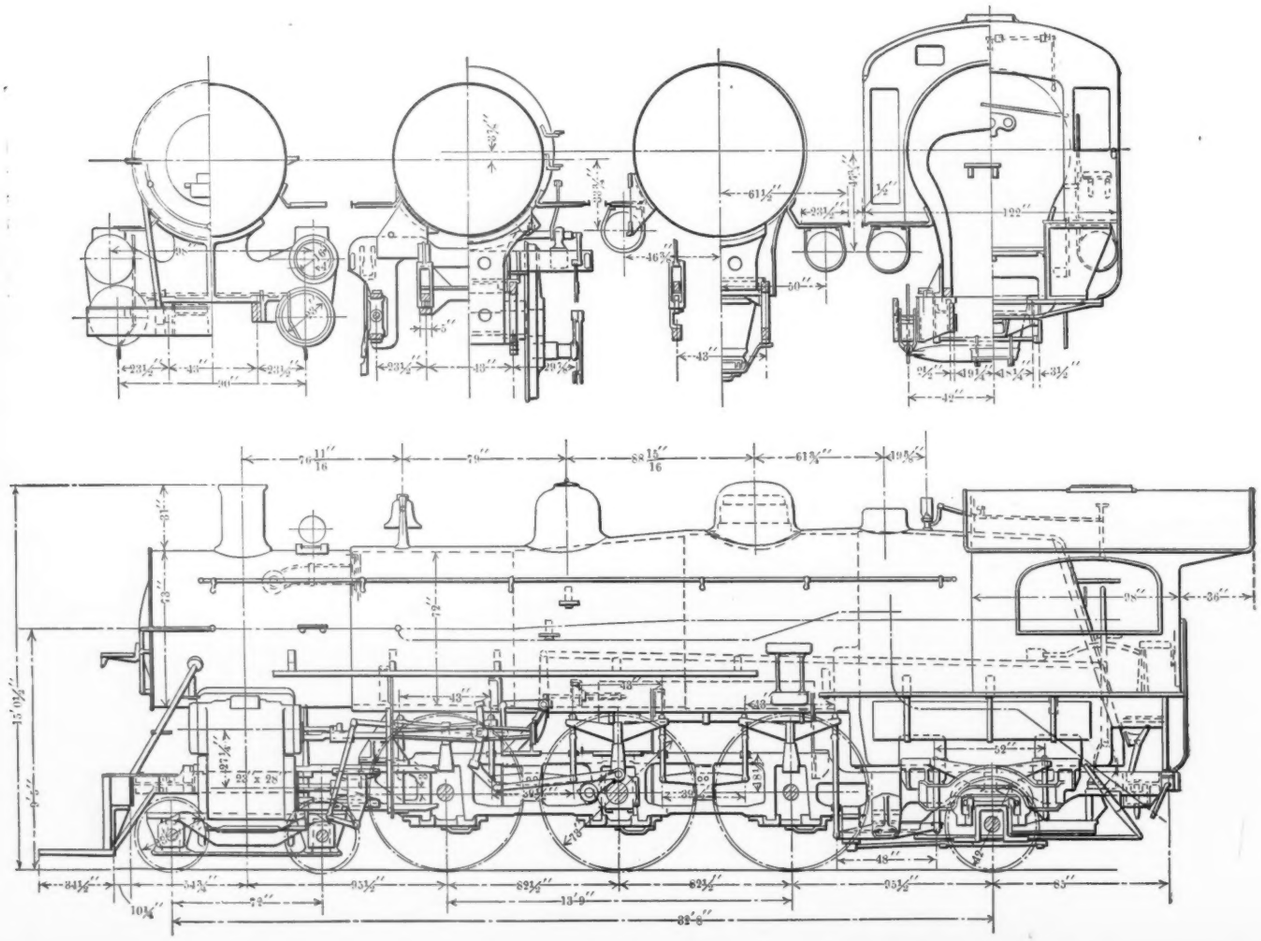
A very high tensile strength can be obtained approaching that of cast steel, but at the expense of the malleability of the product. The writer has seen malleable test bars having a tensile strength of between 60,000 and 70,000 lbs. per square inch, but the ductility and ability to resist shocks of these bars were not equal to that of bars breaking at 40,000 to 45,000 lbs. per square inch.

It was formerly the general belief that the strength of malleable iron was largely in the white skin always found on this material, but it has frequently been demonstrated that the removal of the skin does not proportionately lessen the strength of the casting.—*C. H. Gale, before the Pittsburgh Foundrymen's Association.*

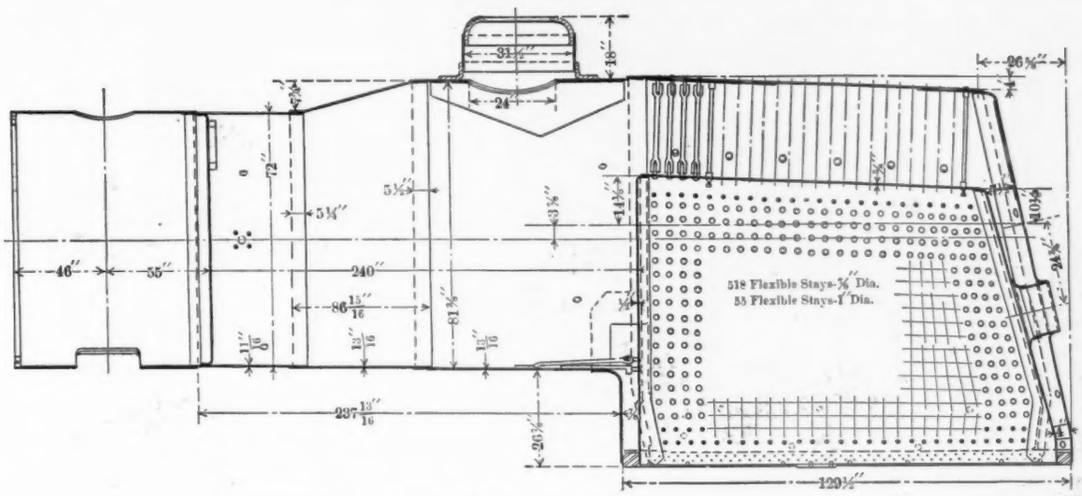
It is safe to say that more than $80,000,000 has been expended upon railroad shops and their equivalent within the last ten years.—*George A. Damon.*



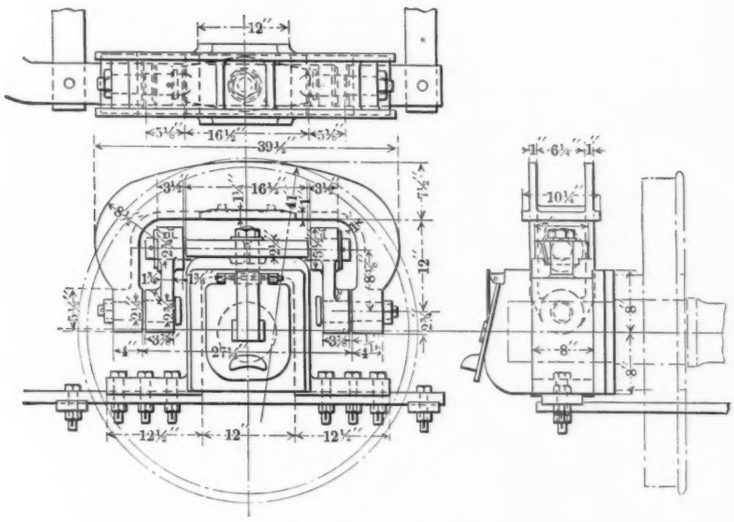
CYLINDERS—PACIFIC TYPE LOCOMOTIVE—CHICAGO AND ALTON [illegible]



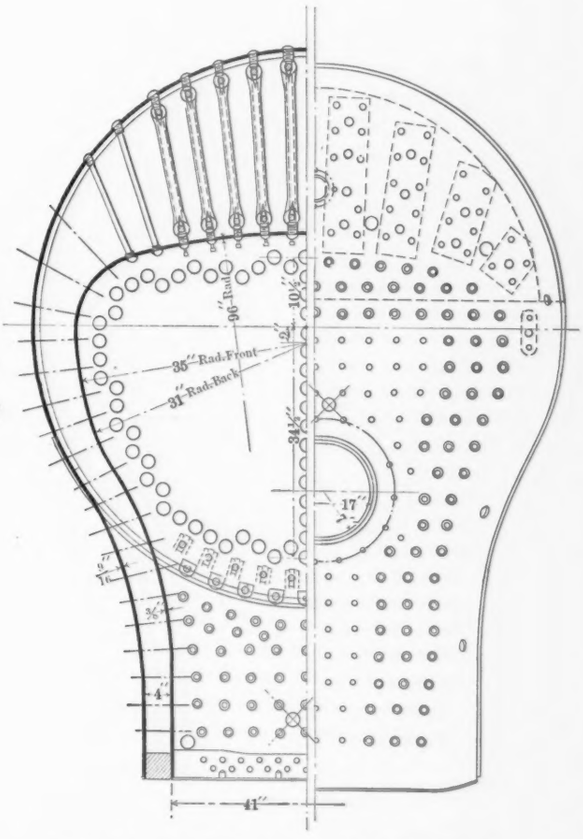
GENERAL ELEVATION AND SECTIONS OF PACIFIC TYPE LOCOMOTIVE—CHICAGO AND ALTON RAILROAD.



LONGITUDINAL SECTION OF BOILER—C. & A. PACIFIC TYPE LOCOMOTIVE.



TRAILING TRUCK—C. & A. LOCOMOTIVE.



SECTION THROUGH FIREBOX AND END ELEVATION.

PACIFIC TYPE LOCOMOTIVE WITH NARROW FIRE BOX.

CHICAGO & ALTON RAILROAD.

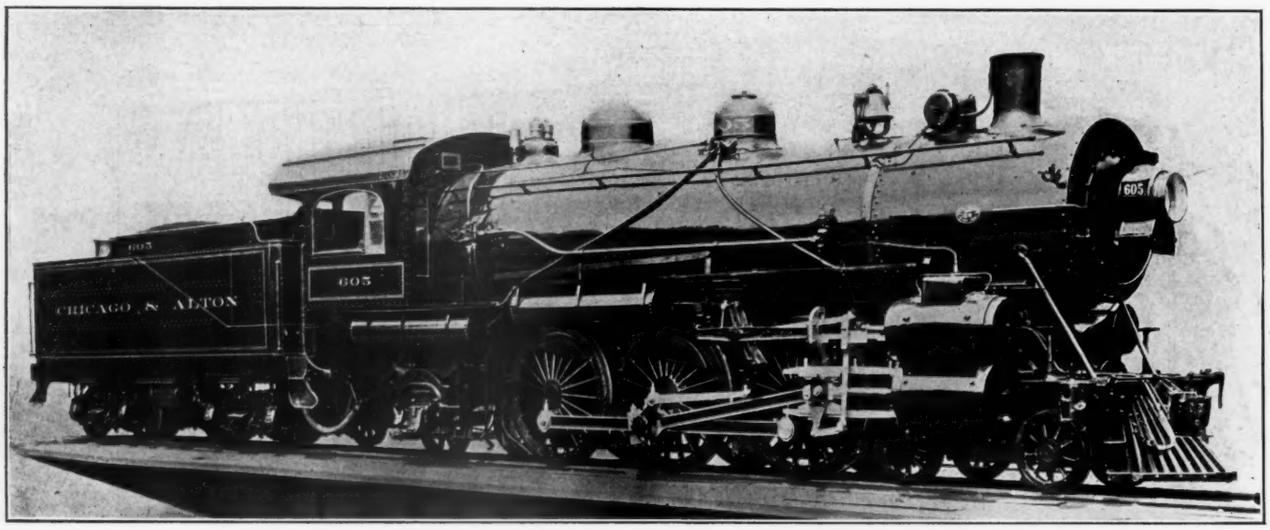
The first standard gauge Pacific type locomotives built by the Baldwin Locomotive Works were delivered early in 1903 to the Chicago & Alton Railroad. There were two engines in this order having driving wheels respectively 73 and 80 in. in diameter. (AMERICAN ENGINEER, March, 1903, page 85.) These locomotives weigh 219,000 lbs. total, have 22 x 28 in. cylinders and were at that time the largest passenger locomotives in the world. In the following year three more engines of the same type were delivered by the same company, which had a total weight of 221,550 lbs. and were again the record holders for size of passenger locomotives. (See AMERICAN ENGINEER, April, 1904, page 133.)

This company has recently received five more Pacific type locomotives from the same works, which, while they are somewhat larger than the earlier ones, do not differ from them in any essential features except the use of the Walschaert valve gear and wagon top boilers with narrow fire boxes. The return to the narrow fire box is the most noticeable feature of the design and follows some experiments which have been made with a similar form of fire box on some Atlantic type locomotives built about two years ago.

The accompanying table will permit a comparison of the general features and important ratios of these locomotives with four other heavy Pacific type engines. The narrow fire box, of course, throws the ratios concerned with it entirely beyond the limits which have been considered proper for this type of engine; in other respects, however, the design is normal.

Road	N. Y. C.	C. & A.	Erie.	N. Y. N. H. & H.	C. B. & Q.
Tractive effort	29,200	34,500	30 300	31,560	31,100
Total weight	266,000	243,200	230,500	229 500	228,000
Weight on drivers	171,500	146,500	149,000	142,500	150,000
Heating surface	4209.9	3927	3326.	3947.4	3932.
Grate area	56.5	33.	56.5	53.5	54.
B. D. factor	550.	640.	699.	585.	585.
Heat. surf. ÷ grate area	74.5	119.	58.7	73.5	71.3
Grate area ÷ vol. cyls.	4.58	2.44	4.7	4.2	4.39
Heat. surf. ÷ vol. cyls.	341.	290.	277.	321.	318.
Ref. in AMER. ENGR.	1908 p. 164		1905 p. 172	1907 p. 431	1906 p. 300

The boiler is of the wagon top type, with a narrow fire box, and has the largest ratio (119) of heating surface to grate area



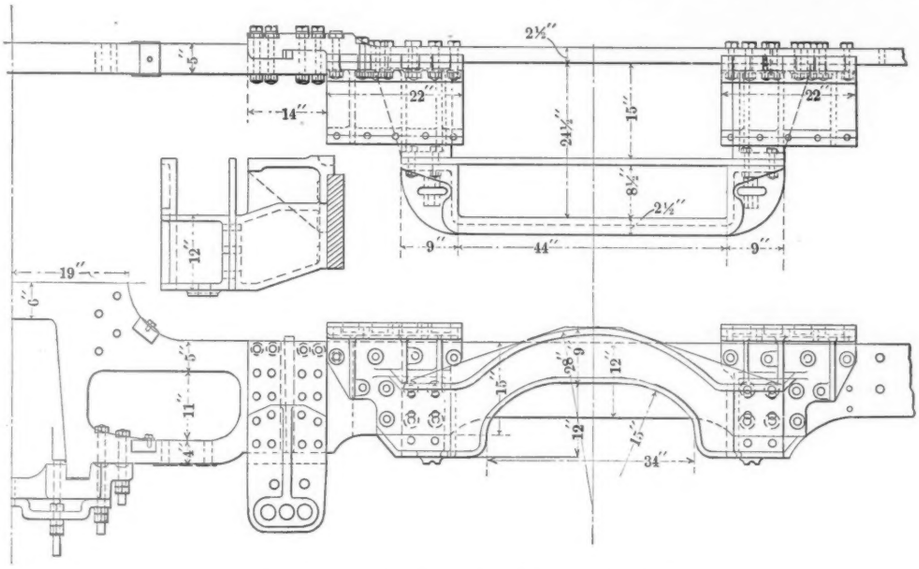
PACIFIC TYPE LOCOMOTIVE WITH NARROW FIREBOX—CHICAGO AND ALTON RAILROAD.

of any locomotive on our records. It has a diameter of 72 in. at the front end, which is enlarged to 83 in. at the dome ring. The grate is horizontal and is rocked in three sections. The dump grate is located at the back end. The fire box has a sloping back head and roof sheet and is radially stayed. The front end of the crown is supported by three rows of sling stays and there are 573 flexible staybolts disposed in the sides, back and throat. The crown and side sheets of both the inside and outside fire boxes are in one piece. Since almost the entire fire box is placed back of the driving wheels large radii could be used in the curvature of the side water legs, which condition has evidently been taken advantage of, as is shown in the section of the fire box. The front end is of the self-clearing type and is equipped with a high single exhaust nozzle and double petticoat pipe. The adjustable diaphragm plate is located in front of the nozzle. The boiler is liberally supplied with means for washing out, there being five blow-off cocks, two in the waist, one in each water leg and one in the throat. Numerous washout plugs are provided, located as shown in the illustration.

The cylinders are 23 in. in diameter by 28 in. stroke and have 16 in. piston valves. They are cast integral with the saddle in the usual manner and the two castings have in addition to the double row of bolts through the flanges, two heavy tie bolts, 2¼ in. in diameter, which pass through the saddle, as is shown in the illustration. The extreme width over the assembled cylinder castings is 10 ft. 2 in. The piston valves have cast iron bodies with L-shaped packing rings and the drifting valves are of the Pennsylvania style, with flat plates over the relief ports in the top of the valve chamber. The vacuum relief valves are placed in the live steam passages and a safety valve, set for 225 lbs. pressure, is located on each cylinder head. The cylinder heads are of cast steel, but the steam chest heads are of cast iron. The arrangement of ports and general dimensions and design of these cylinders is clearly shown in the illustration.

The frames are in two parts, the main frames extending from the front bumper, below the cylinders, to a splice just back of the third driving box pedestal, from which point they are continued with a slab form of trailing frame. The main frames are 5 in. wide, of forged iron and have a section, 5 x 10 in., at their connection to the cylinders. The trailing frames are 2½ in. wide. The pedestal binders are of cast steel and are lugged and bolted to the pedestals. Substantial frame bracing is provided, consisting, in addition to the cast steel foot plate at each end, of bracing of the same material placed just back of the cylinders, between the first and second pair of driving wheels, above the main driving pedestals and in front of the fire box.

The arrangement of the trailing truck, which has outside boxes and a supplementary frame bolted to the trailing frame, is clearly shown in the illustrations and requires no comment. The trailing truck is of the Rushton radial type and advantage is taken



TRAILING TRUCK FRAME—C. & A. PACIFIC TYPE LOCOMOTIVE.

of the cast steel spacing pieces of the frame for use as furnace bearers.

The valve gear details include built up links having plates and end filling blocks of cast steel. Each link is supported by two longitudinal cast steel bearers, which are bolted in front to the guide yoke and at the back to a cross tie, which also serves to support the reverse shaft bearing. The valve stem cross-heads are mounted on guides extending between the guide yoke and cylinders.

The tender is constructed in accordance with the railroad company's standard, the frame being built up of 13 in. channels and is carried on arch bar trucks with cast steel bolsters. The dimensions, weights and ratios of the locomotives are as follows:

GENERAL DATA.

Gauge	4 ft. 8½ in.
Service	Passenger
Fuel	Bit. Coal
Tractive effort	34,500 lbs.
Weight in working order	243,200 lbs.
Weight on drivers	146,500 lbs.
Weight on leading truck	47,600 lbs.
Weight on trailing truck	49,100 lbs.
Weight of engine and tender in working order	405,000 lbs.
Wheel base, driving	13 ft. 9 in.
Wheel base, total	32 ft. 8 in.
Wheel base, engine and tender	65 ft. 8½ in.

RATIOS.

Weight on drivers ÷ tractive effort	4.26
Total weight ÷ tractive effort	7.05
Tractive effort × diam. drivers ÷ heating surface	640.00
Total heating surface ÷ grate area	119.00
Firebox heating surface ÷ total heating surface, per cent	5.24
Weight on drivers ÷ total heating surface	37.30
Total weight ÷ total heating surface	62.00
Volume both cylinders, cu. ft	13.50
Total heating surface ÷ vol. cylinders	290.00
Grate area ÷ vol. cylinders	2.44

CYLINDERS.

Kind	Simple
Diameter and stroke	23 × 28 in.

VALVES.

Kind	Piston
Diameter	16 in.
Greatest travel	6 in.
Lead, constant	¼ in.

WHEELS.

Driving, diameter over tires	73 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	10½ × 12 in.
Driving journals, others, diameter and length	9 × 12 in.
Engine truck wheels, diameter	33 in.
Engine truck, journals	6½ × 12¼ in.
Trailing truck wheels, diameter	42 in.
Trailing truck, journals	8 × 14 in.

BOILER.

Style	W. T.
Working pressure	200 lbs.
Outside diameter of first ring	72 in.
Firebox, length and width	120⅛ × 40¼ in.
Firebox, water space	F., 4½—S. and B., 4 in.
Tubes, number and outside diameter	357—2 in.
Tubes, length	20 ft.
Heating surface, tubes	3,721 sq. ft.
Heating surface, firebox	206 sq. ft.
Heating surface, total	3,927 sq. ft.
Grate area	33 sq. ft.

TENDER.

Tank	Waterbottom
Frame	13 in. channels
Wheels, diameter	36 in.
Water capacity	9,250 gals.
Coal capacity	12½ tons

FORCED LUBRICATION FOR AXLE-BOXES.*

This paper describes a system of forced lubrication as arranged for the driving axle-boxes of some of the steam-cars (motor) of the Taff Vale Railway Company.† Before entering into a detailed description of the system used, it will perhaps be advisable to give a few of the more necessary particulars concerning these cars.

The engine is carried on a four-wheeled truck of 9 feet 6 inches wheel base and 2 feet 10 inches diameter wheels, the boiler (of double-ended locomotive type, lying transversely across the frame), being placed immediately over the center of the leading or driving-axle. The front end of the coach is supported by means of a bogie center, carried between the frames at a distance of 4 feet from the trailing-axle, or 5 feet 6 inches from the leading-axle. When the car is loaded with its full complement of passengers, the weight on the driving-axle is 15 tons 13 cwts., the weight at the rail being 17 tons 6 cwts. The journals are 6 inches diameter by 9½ inches length; therefore the pressure, being two-thirds of the projected area of the brass as bearing area, is 466 lbs. per square inch, the number of the revolutions of the journal, at a speed of 30 miles per hour, being practically 300. With this pressure and high rubbing velocity an undue amount of oil was being used with the ordinary method of lubrication, while cases of the bearings running hot were not infrequent, therefore the following arrangement for lubricating the journals under pressure was adopted.

To a cross-stay in front of the driving-axle, a small gun-metal tank of rectangular section is fixed. On the side of this tank, near the driving-axle and in connection with the tank, two small rotary pumps—right- and left-handed—are fitted, the one for forward running and the other for backward running. These pumps are driven directly from the driving-axle by means of a belt passing over a flanged pulley carried midway between the pumps, the pulley containing on each side of it a roller-clutch, somewhat similar to a free-wheel arrangement, fixed to the driving-spindle of the pumps. By these means, the one belt drives either pump forward or backward, the other pump being free.

Following the process through, for the lubrication of one of the journals, when the car is in motion, oil is pumped from the tank and forced through a coiled copper pipe to the top of the axle-box. An oil channel 8¼ inches long, 9/16 inch deep, is cut in the crown of the box, leaving a margin of metal at each side of the channel of ⅜ inch flat, which is found, when the box is properly bedded to the journal, to be quite sufficient to ensure that it shall be perfectly oil-tight at the pressures attained.

After passing round the journal, the oil is collected in the axle-box cellar, and from there is brought back to the tank by means of a flexible pipe which allows for the rise and fall of the axle-box, care being taken that the reservoir into which the oil is returned sufficiently below the cellar to drain it. At each side of the axle-box cellar a half ring is fitted with bearing area about ⅜ inch wide. These half-rings are bedded well to the axles, and are supported upon a couple of small coil springs which holds the rings up to the journal with a fair pressure, and so prevent the escape of oil along the journal on the bottom side. The supply tank is so arranged that the return oil, after draining from the cellar into it, shall pass through a filter before being again sent through the pump. Such briefly is a general description of the method adopted.

Many points arise, however, in regard to the working of the arrangement which it will be well to explain. In the first place, the pumps when running fast (at a speed of 30 miles per hour, the revolutions of the pump are 440 per minute) deal with a greater quantity of oil than can be accommodated in the circuit at a pressure of, say, 20 lbs. per square inch, above which, in practice, it has not been found advisable to work. A relief valve is therefore fitted to each pump with an adjustable spring which enables the pressure at which each pump shall work to be regulated. The excess oil, when pumping, simply passes back into the tank again, through the relief valve against the pressure of the spring. A small pressure-gauge connected to each pump, and fixed in the driver's cab, shows the pressure of the oil pumped on both forward and backward running, whilst also acting as an indicator should failure of either pump occur at any time. Should this happen from any cause, the ordinary system of lubrication, by means of a lubricating-box in the cab, is at hand. This lubricating-box is also necessary, to enable oil to be put into the axle-boxes after the car has been standing for a day or two, and so avoid starting away with dry axle-boxes.

To prevent the oil from the running pump flowing into the other pump and causing it to run backwards, a small ball-valve is placed in the three-way piece leading from each pump to the circuit. The movement of the axle-boxes relatively to the tank and pumps was met in the first instance by trying different sorts of flexible piping, but finally, ordinary coiled copper piping was adopted, both on account of its comparative durability and of its accessibility at any time.

The belt drive for the pumps at once gives a simple method of driving and one which allows for a small relative motion of the axle and pulley. It is apt, however, to soon become saturated with oil and then slipping occurs. An occasional application of one of the various belting mixtures, however, greatly reduces this slipping. When equal relief-valve springs were put in, it was noticed that the pressure indicated for forward and backward running varied considerably, probably due to the difference in the slip of the belt in each case. The filters in the tank are removable, and are taken out and cleaned at the end of each day's work, the oil being first drawn off through the stop-plug, the thicker part of the oil, after straining, being then replaced by a small supply of fresh oil.

The foregoing description shows one method of dealing with an every-day problem in connection with the running of railway motor-cars, or any rolling stock in which the pressure on the

* Paper presented before the Institute of Mechanical Engineers, July, 1908, Meeting, by T. Hurry Riches and Bertie Reynolds.

† See AMERICAN ENGINEER, April, 1907, p. 134.

STEEL CAR CONSTRUCTION AND MAINTENANCE

By G. E. Carson.

(Editor's Note: In the January issue of this year there appeared an extensive article on "Repairing Steel Cars on the Pittsburgh & Lake Erie Railroad." The following article, which is taken from a paper presented before the Railway Club of Pittsburgh, throws some additional light on this subject and also contains some interesting comments on steel car construction. Mr. Carson's experience with steel cars dates from the time they were introduced on the P. & L. E. R. R., and since this was one of the first roads to adopt them, he is entitled to speak with authority. At the time the article was prepared Mr. Carson was master car builder of the above-mentioned road, but has since been promoted to a similar position on the N. Y. C. & H. R. R. R.)

Construction.

All sheets should be free from waves and roughness, for paint only tends to exaggerate them, giving the car an unfinished appearance. All parts should be free from flash, grease and rust before painting. In all cases where metal is placed against metal the unexposed parts should be coated with a heavy paint mixture before they are riveted or concealed, so as to exclude moisture. During the process of construction a competent inspector should see that the riveting and bolting together of the parts are done in a substantial and workmanlike manner.

In looking at the construction of steel cars I am often led to believe that the designer sometimes forgets the necessity of building a structure that can be repaired with economy and despatch. A few points, which from a repair shop view, should receive careful attention are as follows:

Corner posts on large hopper cars should be in two sections so that it will be unnecessary to remove the entire stake in order to make repairs to the lower portion which is damaged oftener than the top.

Few, if any, of the heavy capacity cars have a place of sufficient strength under which jacks can be placed to raise a loaded car, without damage to the car or endangering the lives of the workmen. All one hundred thousand pound capacity cars should have suitable places for jacking on each end of the car close to the body bolsters. The lighter capacity cars are usually not so defective in this respect.

I believe all center sills should be spliced in front of the body bolsters, as we well know that that portion of the sills between the body bolsters and end sills is most subject to damage; if spliced the damaged sections can be removed and repaired at less cost than where the sill is a continuous member.

Train lines should never be hung between the center sills, as they are inaccessible, either for making repairs or discovering leaky connections, and are therefore neglected by the ordinary inspector. When possible, it is preferable to have the train line and all parts of the air brake close to the outside of car, where leaks can be easily discovered and repairs quickly made.

All cars should be constructed so that it will be possible to apply a train chain to each body bolster in order to haul a defective car to the shop. There are thousands of cars now in service to which chains cannot be applied.

Drop doors on heavy capacity cars should be constructed with as little mechanism as possible, and at the same time the weight should be such that a man of ordinary strength can close them, as the operating of the doors is always in the hands of the inexperienced, who often are unable physicallv to close some of them without assistance.

The floor sheets are of the same thickness as the side sheets. If there is any reason for this I have not discovered it. Floor sheets should be heavier than the side sheets, especially on gondola cars, for the floor sheets wear and rust out long before the side sheets, and when it becomes necessary to renew the floor sheets they must be separated from the side sheets which also show signs of deterioration, especially where they join. In making repairs we cannot help but distort the rivet holes and often tear the side plates. I believe if the floor sheets were heavier the possibility of both sheets wearing out together would be greater and their renewal would insure better results in workmanship and service.

It is noticeable on all gondola cars that the floor sheets sag, forming pockets between the center sills, or, in fact, at any point where there is no support underneath. This, of course, is due to the deterioration of the plates, or the kind of service the cars are in. During wet weather these pockets are filled with water for days at a time on account of insufficient pertoration in the floor sheets; this is very injurious, as the only escape for the water is by evaporation.

Maintenance.

I consider the maintenance of steel cars as not nearly as difficult a proposition under present conditions as the maintenance of wood cars. The road with which I am connected has about 58 per cent. steel equipment, and I wish it was 100 per cent. We do not find it difficult to take proper care of it, but, of course, it is necessary to equip the repair plant with a sufficient number of machines and tools suitable for the work.

I would strongly recommend that all the work be done under cover. With the thermometer near zero it is impossible to heat and straighten repair parts and drive rivets outside, and the result is your repair plant is practically disabled. This is expensive when cars are needed.

Following are a few important machines and tools which I consider necessary to have installed in a steel car repair shop, coming directly under the supervision of the car department. When so installed there is no reason why all despatch work cannot be completed satisfactorily, thereby relieving you of considerable anxiety as to whether some other department (which has all they can do to get out their own rush jobs) is going to finish yours in seasonable time.

A drill press is very necessary, especially when making repairs to foreign cars, for drilling carry irons, draft straps, foot board brackets, truck spring hangers, or other parts which cannot be punched.

A flanging clamp for flanging floor sheets, side sheets, angles, etc.

A stationary riveter, to be used for riveting parts removed for repairs, such as drop doors, door spreaders, draft lugs, truck bolster top plates, stakes to side sheets, etc. I would suggest that as much work as possible be done on the stationary riveters, for the cost per rivet is fully two-thirds less than if driven by hammer.

An air or hydraulic press, fully equipped with formers or dies for the purpose of straightening different shaped material is very essential.

Shears, and punches, and angle, flat, square and round cutters are also necessary. A combination machine capable of performing all of this work can be procured in the open market, and when the shop room is limited it is very desirable.

A steel car jack.* This is not an expensive device, and is certainly a paying investment. It can be used to the very best advantage for jacking cars back into shape, while cold, which have been twisted or bulged by accident. I recall many cases where this device has saved thirty to fifty dollars labor per car.

* See January issue, page 5.

A good-sized heating furnace to admit the largest car sheet and to accommodate about five thousand pounds of various kinds of plates, end sills, etc., is another necessity. A furnace with inside dimensions of 2 ft. 4 in. x 8 ft. x 13 ft. will accommodate this amount of material. By keeping in stock a sufficient amount of new standard parts it will not be necessary to keep the furnace in constant use. I have worked very successfully by using new material to replace damaged parts, allowing the damaged parts to accumulate until there was a sufficient amount on hand to justify heating the furnace, and find it more economical to manage it this way. All material which is straightened or repaired is placed in stock to be used on the next cars that come in. In front of the furnace an iron working plate about 5½ in. x 3 ft. 3 in. x 10 ft. should be placed with the necessary clamps for holding the bent parts in place while they are being straightened.

In every steel car shop, where there is sufficient work to warrant it, there should be an overhead crane for lifting the cars onto trestles instead of jacking; it can also be used for placing and holding the plates until secured by the workmen. By using a crane a couple of men on the ground will handle the largest plates used, otherwise a scaffold and a number of men are necessary to raise a plate and fasten it, accompanied by more or less danger to the men.

ORGANIZATION.

When equipped, as outlined, I have found that on the heaviest of steel car repairs two men are able to handle most of the repairs, but find it practicable to place a gang of six men on three cars and by dividing them into three gangs they can do their own cutting apart, fitting up and riveting, and not be detained by material, which in the meantime is being straightened or machined. I have operated separate gangs to cut apart, fit up, and rivet, but with little success, for it is immaterial to the men who cut apart as to what becomes of the parts removed, and the gangs following lose considerable time in locating the parts when needed. It is also practicable to have stationary rivet heating furnaces in the car shop, placed so that each furnace can supply rivets to three gangs of six men each.

PAINTING.

Painting of steel cars is of the utmost importance, and where we have a great number of them, the repainting process is continuous. A suitable freight car paint shop should be provided, for the painting cannot be done outside in inclement weather. When equipment needs painting you cannot afford to neglect it until favorable weather comes. As a rule, in the summer months the equipment is busy, and there is little opportunity to withdraw it from service, except in cases of emergency. Newly built cars, when ready for the first painting, should have all the flash and rust removed. Unless this is done the flash and paint will continue to fall off in spots as long as any flash remains. In order to remove the flash thoroughly I would recommend the sand blast process. When it is not possible to use this method, would suggest dry cleaning, using steel scratch brushes, sand stone, or any tool which will answer the purpose. Following either process would suggest the application of three coats of paint at twenty-four-hour intervals. Later on, when repainting is necessary, the sand blast should again be used. If this cannot be done, dry clean, and apply two coats of good paint. After taking these precautions to protect the exterior, we find that under ordinary conditions it is necessary to repaint at the expiration of about three years; where conditions are unfavorable to the equipment, the repainting should be governed accordingly.

I cannot be too emphatic as to the necessity of taking the proper care of the exterior, and regret that the interior cannot receive the same attention, but occasionally spraying the interior with crude oil may be found beneficial. At the present time the P. & L. E. R. R. are testing this idea, and I am very sorry the test is not completed so as to enable me to give you the results.

The best of paint should be used in order to prevent rust after painting. The paint which has the greatest wearing elasticity is preferable, as there is less liability for the penetration of moisture. Adhesion is just as important, and to have perfect adhesion the paint should dry from the inside out, the same as good varnish. By using the best materials we need not fear the expansion and contraction of the plates as long as the elasticity remains.

COST OF REPAIRS.

Following are some data showing the relative cost of repairs to steel and wood cars, which I am confident is correct so far as it pertains to the P. & L. E. R. R. equipment repaired on its lines:

100 WOOD CARS REQUIRING HEAVY REPAIRS.

Cost of material	$2,521.00	Average per car	$25.21
Labor and supervision	1,631.00	" " "	16.31
Total	$4,152.00	Total	$41.52

100 STEEL CARS REQUIRING HEAVY REPAIRS.

Cost of material	$3,424.00	Average per car	$34.24
Labor and supervision	2,292.00	" " "	22.92
Total	$5,716.00	Total	$57.16

A very accurate record was kept of the average number of times the different classes of cars were called into the shop for light, medium and heavy repairs, covering a period of one year.

Average number of times one wood coal car was in shop during one year	7 times
Average cost of repairs each time in shop	$16.23
Average number of times one wood coke car was in shop during one year	6 times
Average cost of repairs each time in shop	$10.74
Average number of times one steel car was in shop during one year	1 1/3 times
Average cost of repairs each time in shop	$6.74

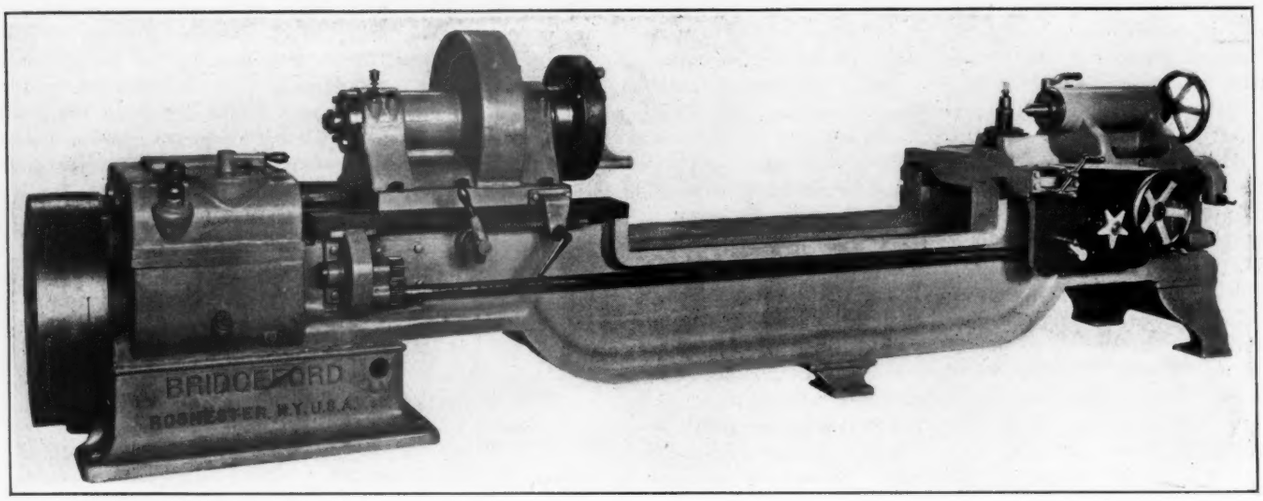
The above figures represent the cost of material and labor, less scrap credits, and is the average cost of the total repairs to:—

806	Heavy	steel	car	repairs.	
1,359	Medium	"	"	"	
9,180	Light	"	"	"	
11,338					
707	Heavy	wood	coal	car	repairs.
513	"	"	coke	"	"
3,018	Medium	"	coal	"	"
3,354	"	"	coke	"	"
12,438	Light	"	coal	"	"
12,040	"	"	coke	"	"
32,070					

Your attention is called particularly to the number of times a steel and a wood car are called into the shop per year, and to the difference in the cost of maintenance per car. Of course, it must be understood that when the time comes to renew the steel car parts which are worn out, the figures shown will be inadequate for the reason that we are comparing steel cars with a collection of new and old wood cars, but even so, I believe, if we give the steel cars the proper care their maintenance will be less in the end than that of wood cars.

SKILL WITH THE SCOOP means economy in the use of fuel, but better still, it means a good steamer, while a lack of knowledge makes a poor steamer. It takes steam to move trains and plenty of steam means quick dispatch, which is a much-neglected form of economy in these days of heavy tonnage trains that move so slowly that they tie up the road and keep the yards blocked.—*C. B. Conger before the Traveling Engineers' Association.*

CABLES OF THE MANHATTAN BRIDGE.—The cables of the new Manhattan bridge which is now in course of construction will consist of 9,472 steel wires, each being slightly over 3/16 in. diameter. This will make the finished cables about 21½ inches diameter. Each wire has a tensile strength of about 6,000 lbs., making the strength of each cable over 28,000 lbs. There are to be four of these cables in the bridge.



BRIDGEFORD HEAVY GAP LATHE FOR REFINISHING CAR AXLES.

HEAVY GAP LATHE.

The heavy gap lathe, illustrated herewith, is manufactured by the Bridgeford Machine Tool Works, Rochester, N. Y., and is intended for refinishing car axle journals without removing the wheels; it may also be used as a single end axle lathe, it being possible to move the headstock on the bed, by the rack and pinion, so as to bring the wheel fit within the range of the carriage. It may also be arranged for refinishing engine truck axle journals by providing an extra carriage between the wheels, leaving a short gap on each side.

The machine is driven through the 30 in. pulley by an 8 in. belt. Three different speeds may be obtained by a mechanical speed changing device, which is operated by levers, conveniently located on the casing to the right of the driving pulley. The gears in this device are all of heavy cut steel and run in oil. The power is transmitted from the change speed device to the driving head by a shaft, placed within the frame, and a set of gears. The driving head is of very strong construction and the end thrust on the spindle is taken up by an adjustable step. The driving gear is entirely encased and the head is furnished with a double self-centering steel driver.

The tailstock is of the ordinary type of construction and has a bearing on the bed 24 in. in length. It may be set over for taper turning when desired. The carriages are driven by a splined feed shaft, through a rack and pinion. The direction of the feed is changed at the apron, the carriages being independent of each other. A feed-box, operated by a lever conveniently placed in front of the headstock, furnishes four changes of feed, ranging from 1/16 to 3/16 in., to one turn of the axle. The carriages have a bearing at the back of the bed, which takes up the forward thrust, thus overcoming the tendency to raise them from the V's when the burnisher is used. The bed is of rigid construction strongly reinforced by cross ties of box pattern. The swing over the ways is 27 in.; over the carriage 14 in. and in the gap 45 in. The distance between centers is 8 ft. 4 in. The weight of the machine is about 15,500 lbs.

ASSOCIATION OF CAR LIGHTING ENGINEERS.

At a meeting held in the office of E. W. Newcomb, signal engineer, O. S. L. R. R., at Ogden, May, 1908, an organization was formed to be known as the Association of Car Lighting Engineers; the following officers were elected:

President, A. J. Farrely, electrical engineer, C. & N. W. R. R.; first vice-president, E. M. Cutting, signal supervisor, S. P. System; second vice-president, A. J. Collett, electrical engineer, U. P. R. R. Co.; secretary and treasurer, G. B. Colgrove, chief electrician, I. C. R. R. Executive committee: H. C. Malloy, chief electrician, L. S. & M. S. R. R.; O. W. Ott, chief draftsman, O. S. L. R. R.; G. W. Murray, chief electrician, S. P. L. A. & S. L. R. R.; C. W. Terry, chief electrician, Soo Line.

Membership in the association is to be divided into active and associate members. For active membership all men directly or indirectly in charge of electric car lighting on any railroad in the United States or Canada are eligible. For associate membership all men who have been engaged in electric car lighting work for a period of over one year on any railroad in the United States or Canada are eligible, on recommendation of their superior; representatives of all companies engaged in the railway supply business are also eligible to associate membership.

At the first meeting a general discussion of train lighting matters was indulged in and the president was authorized to assign a list of subjects upon which papers will be prepared by the different members, as designated by the president, for discussion at the next meeting. The object of this association is to further the interests of car lighting, particularly electric car lighting, and try to bring about standards covering interchanged equipment on the various railroads of the United States and Canada. It is the intention to hold meetings once a year, or oftener, at which subjects pertaining to train lighting will be discussed in a similar manner to that now in vogue at the various railway clubs. The next meeting of the association will be held in Chicago some time in October.

THE MAGNITUDE OF THE BAGGAGE DEPARTMENT of a big railway, as well as the many curious items it covers, was well illustrated by a statement recently issued by the baggage officials of the Canadian Pacific Ry., showing their business for the past year. 7,630,139 pieces of baggage were handled during the year. This is an increase of 1,305,608 pieces over the record of last year. For this service the company received excess baggage charges, storage charges, special delivery, etc., amounting to $339,178. It is noticeable in the report that there were large increases in every line of baggage business except bicycles, showing that the passenger business has not suffered anything like the decline that has marked the freight department of railroad work during the past six months. During the year the Canadian Pacific baggage department handled 16,003 bicycles, 12,427 dogs, 8,153 baby carriages, and 1,461 corpses, the latter having to travel as baggage on regular passenger tickets. The bicycle traffic dropped by over a thousand from the previous year, everything else, however, showing an increase, dogs going up from 11,198 to 12,427, and baby carriages almost doubling in number

THE ENGINEER AND HIS WORK.—It is distinctly the business of the engineer to lessen waste—wastes of material, wastes of friction, wastes of design, wastes of effort, wastes due to crude organization and administration—in a word, wastes due to inefficiency. The field is the largest and richest into which any worker was ever turned.—*Harrington Emerson in The Engineering Magazine.*

15-INCH SINGLE GEARED CRANK SHAPER.

The American Tool Works Company, of Cincinnati, has recently brought out a new 15 in. single geared crank shaper which embodies a number of important improvements. Some idea of the capacity of this machine may be gained from the following data from tests made at the works.

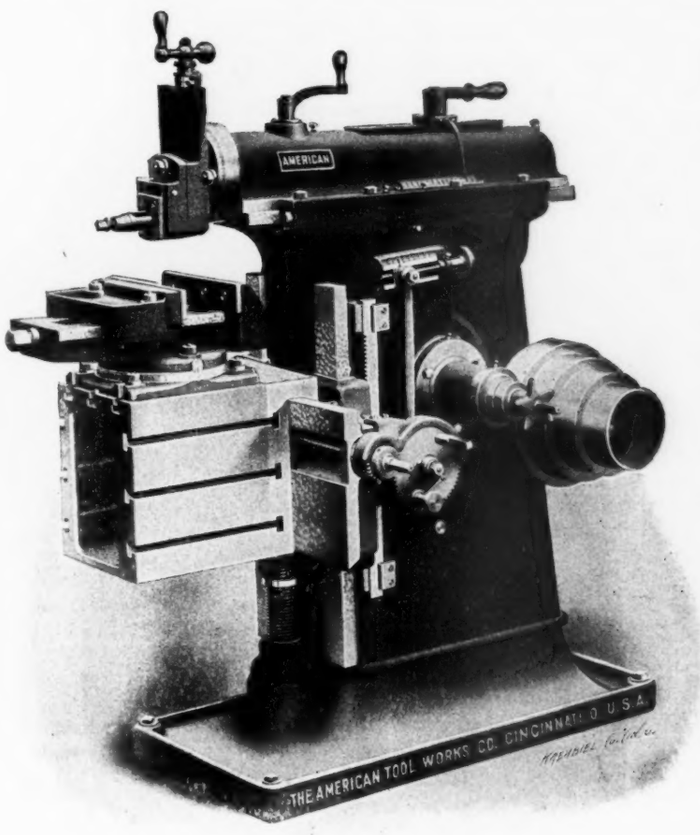
CAST IRON TEST.

⅛"	deep,	.016	feed,	2	notches,						
¼"	"	.040	"	5	"	}	4"	long,	30	strokes	per min.
⅛"	"	.048	"	6	"						
⅛"	"	.024	"	3	"		12"	"	20	"	" "

STEEL TEST.

⅛"	deep,	.016	feed,	2	notches,		2½"	long,	30	strokes	per min.
⅛"	"	.016	"	2	"		10"	"	20	"	" "

The shaper is of heavy and substantial design to meet the most severe requirements. The stroke of the ram is positive



AMERICAN SINGLE GEARED CRANK SHAPER.

and has four rates of speed ranging from 20 to 65 strokes per minute. The length of the stroke may easily be changed without stopping the machine. The device for positioning the stroke is located on the ram near the head and may be manipulated while the machine is in operation. The pointer on the ram and an index indicate the length of the stroke. The rocker arm, of rigid and heavy construction, is so arranged as to give the ram a practically uniform rate of speed during the entire stroke; it also provides for an exceedingly quick return. The driving mechanism is sufficiently powerful for the heaviest work adapted to this type of machine.

The cross feed is of a new patented design, is variable and automatic, and has a range of from .008 to .200 in., any one of the feeds being instantly obtainable while the machine is in operation. It is supplied with a pointer and graduations either side of zero reading from 1 to 25 notches, each notch representing .008 feed. The feed mechanism is so constructed as to render unnecessary any adjustment due to a change in position of the rail. The feed may be thrown in or out or reversed through the knob on the large feed gear. This gear is also supplied with a square rod to receive a crank, by which the table may be quickly advanced or returned.

The column is deep and wide, slightly tapering toward the top, and is carefully braced and reinforced internally, so as to make it very rigid. It projects at the top at both the front and the rear, providing a long bearing for the ram. The base is deep and strongly ribbed and of pan construction to catch all oil drippings, thus protecting the floor. The ram is carefully designed to afford uniform rigidity throughout the length of the stroke and has large bearings on the column with a continuous taper gib, having an end screw attachment for taking up wear. The head may be operated at any angle within an arc of 100 degs. The down slide is fitted with a continuous taper gib having an end screw adjustment for taking up wear. The down feed is of unusual length, the feed screw having an adjustable graduated collar reading to .001 in. It is equipped with a large tool post for using holders with inserted cutters.

The table is of substantial construction and is readily detachable. The apron is provided with a continuous taper gib having an end screw adjustment for taking up wear and has T slots for clamping work when the table is removed. An automatic stop releases the feed and thus prevents breakage when the tool is fed into the cut or if the apron should accidentally be fed to its limit in either direction. The cross rail is of box form, is of exceptional length and provided with a large diameter telescopic elevating screw, having a ball bearing thrust bearing.

The rocker arm is of double section at the top, and this, in connection with an opening in the column, permits the key-seating of shafts as large as 2½ in. in diameter. Larger shafts may be key-seated by setting over the table and setting the head at an angle. Special attention has been given to the lubrication of all parts. The ram slides are provided with felt wipers at both the front and center of the column, assisting in perfect lubrication, also preventing oil from dripping down over the front of the machine. An oil pocket is cast integral with the column at the rear, storing any waste of oil, which may be drawn off at any time through a pipe extending from the rear of the column. A large quantity of oil is stored in a pocket cast integral with the arm with suitable means of distribution, insuring thorough lubrication of the crank pin and the sliding block in the rocker arm. The maximum length of stroke is 15¼ in.; the down feed to the head is 6 in.; the vertical travel of the table is 14 in.; the horizontal travel is 18 in.

Skill in Handling the Reverse Lever and Throttle gets as many heavy trains in on time as big locomotives carrying a high steam pressure. Skill with the injector counts for as much as skill with the scoop if the steam gauge is any guide.—*C. B. Conger before the Traveling Engineers' Association.*

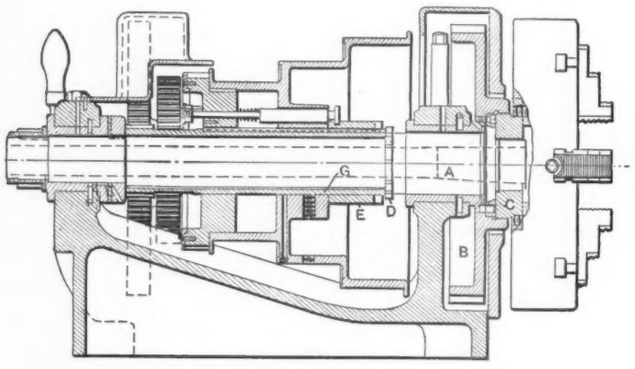
Mechanical Draftsmen Wanted.—The United States Civil Service Commission announces an examination on October 21 to 23 inclusive, to secure eligibles for the position of skilled mechanical draftsman in the ordnance department. The salary to start with will be from $1,000 to $1,200 a year. Application should be made to the United States Civil Service Commission, Washington, D. C., for information concerning the examination. It will be necessary for the applications to be properly executed and filed before October 10th.

Railway Signal Association.—The twelfth annual convention of this association will be held in the New Willard Hotel, Washington, D. C., October 13, 14 and 15. A booklet is being issued by the secretary, C. C. Rosenberg, 12 Linden street, Bethlehem, Pa., which includes the program for the meeting, a list of the members of the different committees and a complete list of all members of the association with their positions and addresses.

18-INCH CONE-HEAD ENGINE LATHE.

An 18 in. by 8 ft., cone-head, Schellenbach, engine lathe, made by The John B. Morris Foundry Company, Cincinnati, O., is illustrated herewith. It is of the same general design as the geared-head lathe, made by this company, except that the cone-head is used.

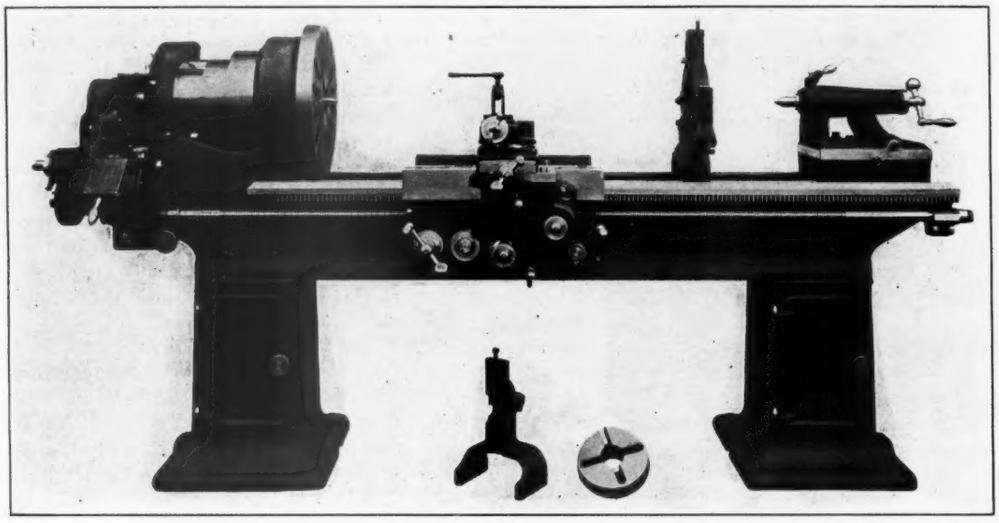
A sectional view of the headstock is shown on the drawing. The spindle A has a flange at its right end and receives the face gear B, which is dowled and screwed to it. This face gear B has internal threads and receives the face plate or the chuck. It will be seen that the chuck plate C fits the counterbore of the chuck and is bored to fit the end of the spindle and threaded on the outside to screw into the face gear B. Thus, when pressure is exerted against the chuck it clamps the flange of the spindle tightly between the chuck plate, C, and the face gear, B. This arrangement eliminates tortional strains within the spindle when running in back gear. Clutch teeth D are formed upon the spindle and engage the clutch E, which is splined to the cone pinion sleeve G. This clutch is operated at the back end of the headstock by a spring seated plunger which passes through the cone pulley. The plunger is provided with a knurl with a detent pin for holding it out of engagement.



CROSS-SECTION OF HEADSTOCK.

A three step cone is provided for a 2 in. double belt, the largest diameter being 12 in.; there are two changes of back gearing, making in all nine changes of speed with a single speed of the countershaft. The countershaft is provided with double friction pulleys, and where back motion is not needed it may be driven at two different speeds, thus giving the spindle six open belt speeds and twelve back gear speeds. The back gear is operated with an eccentric shaft in the ordinary manner. It will be noticed that the overhang of the chuck, from the face of the jaws to the front spindle bearing, is not as great as with the ordinary type of lathe. All gearing on the head is enclosed and is of coarse pitch.

A quick change device gives a range of threads from 2 to 112. A double plate apron and a special feature for rough chasing threads by the ordinary rack feed in place of the lead screw are provided, the object being to preserve the accuracy of the screw and to use it for only accurate chasing. A single wrench operates every adjusting screw throughout the machine, including the tightening of the tail-stock to the shears. The cabinet legs have hinged doors with latches operated by knobs. This lathe is also made in 14 and 16 in. sizes, and with a plain system of change gears, as well as with the quick change, as shown.



SCHELLENBACH 18-INCH CONE-HEAD ENGINE LATHE.

RAILROAD REPAIR SHOP ARRANGEMENT.

Certain fundamental principles should be recognized before attempting a railroad shop arrangement, and as far as possible the arrangement should be worked over until it satisfies these requirements, always recognizing exceptions due to individual conditions.

(1) Liberal space (say 100 per cent.) should be allowed for the extension of each department.

(2) The store house (with administrative offices in one of the upper floors) should be central, convenient to all departments, and easy of access on two tracks from the main line service track.

(3) The forge shop should be convenient to both the locomotive and car repair departments.

(4) The power house should be central and near the planing mill and repair tracks in order to burn refuse.

(5) Yard cranes should be arranged to serve between the store house platforms and all departments.

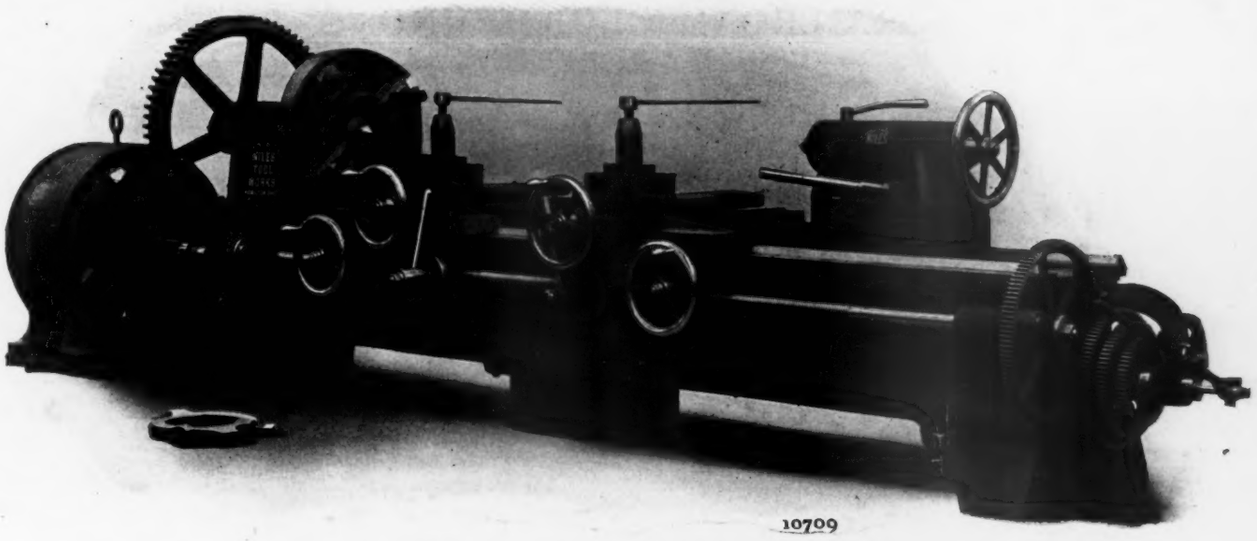
(6) The roundhouse should be very near the shop, or located far enough away to justify a separate machine shop for light repairs.

(7) Tracks, cranes, telphers, and storage spaces should be arranged to insure the movement of materials with the greatest economy of time and labor.

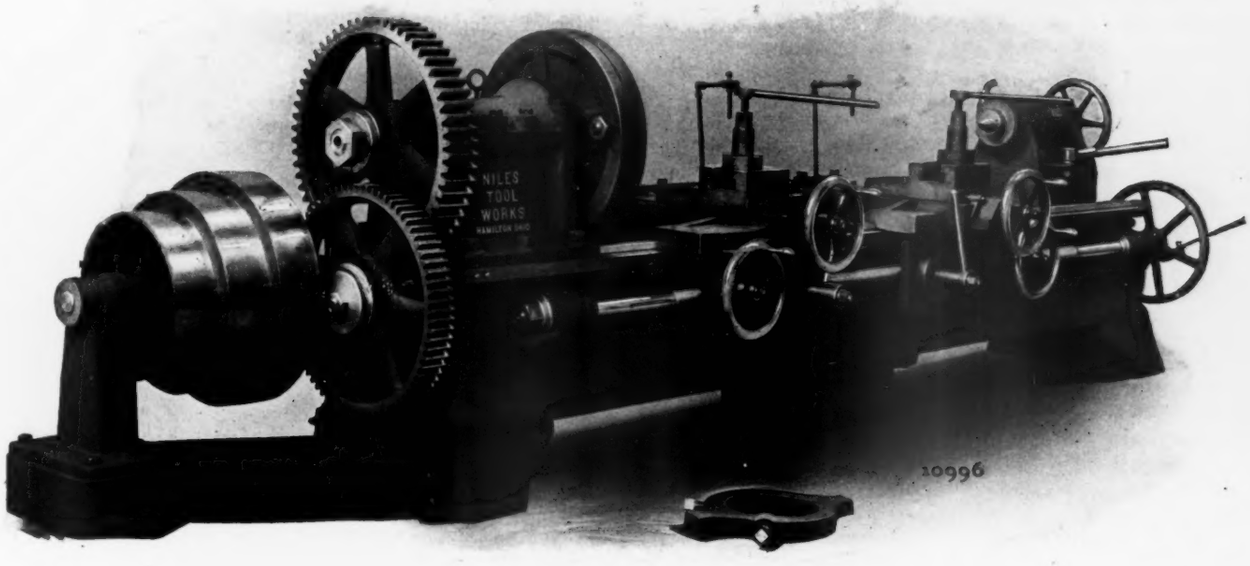
(8) Some consideration should be given to the appearance of the shops and accessory storage facilities, lumber yards, etc., from the main line.

(9) The advantages of a short tunnel of ample cross section for the use of the various steam air, and water piping systems should not be forgotten.

(10) The possibilities of the adoption of longer and heavier



NILES LOCOMOTIVE AXLE LATHE, MOTOR DRIVEN.



LOCOMOTIVE AXLE LATHE, NILES-BEMENT-POND COMPANY.

engines similar to the consolidation or articulated types should be considered, and some provision made for present or future repair facilities for these larger engines.

(11) The cost of the shops should be consistent with not only the actual necessities, but in proportion to the refinements which the road can afford. All expenditures over and above those required for actual needs should be capitalized and made to show a satisfactory return on the investment.—*George A. Damon before the Canadian Railway Club.*

LOCOMOTIVE AXLE LATHE.

The locomotive axle lathe, shown in the illustrations, is made at the Niles works of the Niles-Bement-Pond Co. and is of a very substantial design, intended for turning the heaviest driving axles. It has a swing of 14 in. over the carriage and a maximum distance between centers of 8 ft. The axle is driven by the double equalizing driver plate. The tail stock is of the usual form. The two carriages, right and left hand, are equipped with a positive power feed having three changes. Both carriages have opening nuts, quick hand movement and hand cross feed.

A pump keeps the lubricant in circulation, it being collected in a reservoir in the center leg of the machine. Brackets are placed at the back of the machine to which formers of any desired shape may be attached for giving the proper contour to the axle. Where desired a crane with a convenient hand hoist for lifting the axle in and out may be placed at the back of the bed. With the belt driven machine a 5½ in. belt is used; the lathe may be driven by a direct connected variable speed motor of 25 h.p. capacity, mounted on a plate attached to the bed as shown.

ELECTRICITY IN AGRICULTURE.—In England, electricity has been experimentally applied to agriculture on a large scale by Sir Oliver Lodge. Wires were strung on 15-foot poles equipped with high-tension insulators, and placed 30 feet apart over 19½ acres of ground. A dynamo driven by a 2-horsepower oil engine supplied 3 amperes at 220 volts, which was raised to 100,000 volts by an induction coil. It then passed through rectifiers, one pole of which was connected to the system of overhead wires and the other grounded. The leakage from these wires is said to have stimulated the plant growth so that crops of wheat, barley and strawberries showed an increase of from 25 to 35 per cent. The flour made from the wheat was of better quality, and sold at a higher price, as it contained a larger proportion of dry glutens and was better baking.—*The Journal of Electricity, Power and Gas.*

RAILROAD CLUB DOINGS

Canadian Railway Club.—Next meeting, Tuesday, October 6, at the Windsor Hotel, Montreal, Can. A. D. Thornton, general technical superintendent of the Canadian Rubber Company, will give an address on "Chemistry of Rubber," explaining in detail its use in the manufacture of rubber goods for mechanical purposes, more especially as applied to railroad use. The lecture will be illustrated with lantern slides.

R. E. Johnson in his paper on "Producer Gas Power Plants," presented at the September meeting, described a producer gas power plant of the suction type; presented some data as to the comparative cost of fuel for gas and steam power plants of 100 h.p. capacity; discussed the necessity of conserving our fuel supply; considered the difficulties which had retarded the more extensive introduction of producer gas and gas engine plants and directed attention to some important improvements which have been made in gas engine design and operation.

Secretary, James Powell, P. O. Box 7, St. Lambert, near Montreal.

Central Railway Club (Buffalo, N. Y.).—Next meeting, Friday, November 9. Secretary, H. D. Vought, 95 Liberty street, New York City.

New England Railroad Club (Boston, Mass.).—Next meeting, Tuesday, October 13. A paper on "Terminal Facilities for Handling Locomotives" will be presented by R. D. Smith, superintendent of motive power of the Boston & Albany Railroad. Secretary, G. H. Frazier, 10 Oliver street, Boston.

New York Railroad Club.—Next meeting, Friday, October 16. Raffe Emerson in his paper on "Better Service at Reduced Cost," at the September meeting, used the handling of locomotive supplies as an example of the results which may be accomplished by standardization and better supervision in improved service and reduced cost. His treatment of this question was in some respects similar to that of E. Fish Ensie in articles on the same subject in the January and March issues of this journal. In addition Mr. Emerson presented a number of lantern views showing similar results which had been obtained in other departments.

Secretary, H. D. Vought, 95 Liberty street, New York.

Railway Club of Pittsburg.—Next meeting, Friday, October 23. It has been practically decided to turn this into a "smoker." (*Business must be dull in the "smoky city."*)

C. W. Cross, superintendent of apprentices of the New York Central Lines, presented a paper on "Practical Results from a Modern Apprenticeship System" at the September meeting. The paper is unique because of the fact that it practically confines itself to the consideration of benefits of improved apprenticeship which are thus far apparent. It is surprising to note the importance of these, especially when we consider the comparatively short time in which this new system has been in operation on the New York Central Lines. A feature of the paper, which adds greatly to its value, is a bibliography consisting of a list of some of the more important articles on apprenticeship, which have been published during the past few years. This feature is commended to those who expect to prepare papers for railroad clubs and even in some cases to those who contribute articles to the technical press.

Secretary, J. D. Conway, P. & L. E. R. R., Pittsburg, Pa.

Richmond Railroad Club.—Next meeting, Monday, October 12. Alexander Kearney, assistant superintendent of motive power of the Norfolk & Western Railway, will talk to the club on "Boiler Tubes and the Beading of Tube Ends." The first meeting of the season was held on September 14th, at which time addresses were made by President W. H. White, of the R. F. & P. and the Washington Southern, and President Stevens, of the C. & O.

Secretary, F. O. Robinson, Richmond, Va.

St. Louis Railway Club.—Next meeting, Friday, October 9. Secretary, B. W. Frauenthal, St. Louis, Mo.

Western Railway Club (Chicago).—Next meeting, Tuesday, October 20. Secretary, J. W. Taylor, 390 Old Colony Bldg., Chicago, Ill.

Arthur Hale, general superintendent transportation, Baltimore & Ohio, and chairman of the committee on car efficiency of the American Railway Association, gave an interesting talk on "Progress Toward Car Efficiency" at the September meeting. He told of the work of the car efficiency committee and of the difficulties it had met with; also some of the things which it is trying to do at present.

Some Comments on the Railway Club Department.

To the Editor:

I am sure that a department for the discussion of the work done by the various railroad clubs would be an interesting feature for the American Engineer, and am glad to note that you think of trying it.

It occurs to me that possibly a very brief summary of the most important points brought out by the various papers and discussions would be valuable, particularly to such busy officials as do not have time to read the proceedings in full.

I think it would also be of much interest and assistance to many of the railroad clubs if you could present a list of suggestions for papers, as the question of obtaining live topics has been one of the most difficult for the Western Railway Club to handle to the satisfaction of its officers.

M. K. Barnum.

C. B. & Q. R. R., Chicago, Ill.

To the Editor:

In the September number of your very worthy paper the column entitled "What the Railroad Clubs Will Do in September," struck me as being a splendid move and one from which I anticipate being greatly benefited. I read your editorial after seeing the above mentioned title and I was glad to note that you intended making it a permanent item for each month, if you could secure the co-operation of the officers concerned, which I trust you will be able to do. It would be of much benefit to the membership of the various clubs to know what the others are doing and when a very able paper is presented in one club, the members of other clubs, by hearing of it through the column set aside for this particular purpose, would be enabled to know when to secure a copy of it.

I have found it very difficult, in trying to keep up with all that was being done in the various associations, to get a list of subjects, etc., but your proposed effort will be of much assistance to all those that want to know just what is being done in the various clubs.

L. W. Wallace.

Purdue University, Lafayette, Ind.

To the Editor:

I regard your new feature in announcing dates and topics of the various railroad clubs a very convenient and useful way of bringing this information to your readers. We can hardly be members of all of the railroad clubs, but at times would like very much to keep track of what some of them are doing, and to get this in the shape which you have put it is to my mind very desirable.

Some time when you are wanting a topic to enlarge on, would suggest advising the younger men to take advantage of railroad club opportunities for discussion. Many of these young men in course of time may be active in the associations and club train-

ing is invaluable as developing facility for easy speaking when on the floor and taking part in debate.

C. A. Seley.

Rock Island Lines, Chicago, Ill.

Editor's Note.*

Mr. Seley's suggestion is a splendid one. The railroad clubs can be used to considerable advantage by the ambitious young man, in assisting him to extend his acquaintance and to some extent to show his associates and superiors the kind of stuff he is made of. Many motive power officials can show how taking part in the work of the railroad clubs, or writing for the technical press, has been the direct means of assisting them to secure advancement.

A young man should never attempt to take part in a railroad club discussion on the spur of the moment, unless he is thoroughly familiar with the subject. It must be remembered that while it is possible to create a favorable impression by good logic, clear cut expression and evidence of a thorough knowledge of the subject under discussion, it is just as much of a disadvantage if the subject is not handled properly.

It is always advisable to prepare a written discussion beforehand. This may be read, although, if possible, it is better to use such notes as a guide and to speak extemporaneously. The advantage of writing the discussion beforehand is that it crystallizes the subject in one's mind. No matter how simple a piece of work you may perform if you attempt to write a description of it you usually find that you have yet much to learn concerning it, and often are led to see where you could make a great improvement.

In this connection the suggestion might be made that the club secretaries should try to issue the advance papers as much as possible in advance of the time of meeting. Under present conditions, in some of the clubs, the advance papers are received so late that it is almost impossible to give the proper amount of time to studying them before the meeting. The result might be not only to make it possible to have the young men take part more generally, but some of the older members would come to the meeting with a clearer idea of the subject under discussion and would not waste the time of the club by talking to cross purposes. At same time it would make it possible for the speaker of the evening to present the subject in brief abstract, allowing more time for a thorough discussion.

Rapid Ore Handling.—There are four machines at Cleveland, Ohio, for unloading ore vessels which can accurately weigh and deliver a car load of ore from vessel to car in about seven seconds.

Evening Classes at Columbia.—Columbia University will, during the fall and winter, offer twenty evening courses especially adapted to the needs of technical and professional workers. These include work in applied mechanics, applied physics, architecture, electricity, fine arts, industrial chemistry, mathematics and surveying and structures. The work will begin on October 26 and will continue for twenty-five weeks. A full description of the courses is contained in the "announcement of extension teaching," which may be obtained on application to the director of extension teaching, Columbia University, New York City.

Total Power Used in United States.—Using the data furnished by the census returns of 1900, 1902, and 1905 as a basis and applying the prevailing rate of increase in the industries included in these reports, and adding an equivalent amount for the steam railroads, it is estimated that the total installed capacity of prime movers in all our land industries for the year 1908 approximates 30,000,000 h.p. The average load on steam and other engines is much less than their rated capacity, and, owing to the overlapping of loads, it it probable that the total average load does not exceed one-third or one-quarter of this amount.—*H. St. Clair Putnam at the Conference on Natural Resources.*

* See also December, 1907, issue, page 473.

SUGGESTIONS AS TO AN IMPROVED SYSTEM OF BILLING FOR REPAIRS UNDER M. C. B. RULES.

To the Editor:

Referring to a suggestion which has been made looking toward doing away with the complicated system of billing for repairs under the M. C. B. rules by billing for repairs at an average cost per mile, or per day, as the rental is billed for. There seems to me to be serious objections to this. In the first place, it might be difficult to arrive at a rate per mile, or per day, which would be satisfactory to all the interests concerned.

Presuming that this difficulty was overcome there would remain the seemingly unanswerable objection that such an arrangement would inevitably lead to a neglect of equipment; it would be to every one's interest to get rid of cars with existing defects rather than to repair them. At the present time, I believe that under the M. C. B. rules, while it is not probable that any road can make any money by repairing foreign cars, yet in most cases there would be such a small loss that in general the tendency is to repair all defects as soon as possible after their happening. This is a factor which must be considered as of great value. Under the proposed change of the rules, the general tendency would be to try to dispose of cars to connecting lines with all the existing defects they could be made to stand for. This would not seem to be a desirable state of affairs.

There is another way of doing away with all the expensive routine of billing for car repairs, and while there are serious objections to it, it seems to me that it would dispense with a great deal of the red tape of the present rules without the attendant difficulty of tending to prevent a general habit of keeping foreign cars in a reasonably good state of repairs. My idea would take us back to the old rules, and about as far beyond them as the present rules are developed on the side of the owner being responsible for all except wreck damage; for although the rules make a good many exceptions beside actual wreck damage, it is altogether probable that there are "adjustments" which manage to throw almost all defects into the "owner's" class unless they are so serious as to be beyond question due to a wreck.

Now, if the rules should be changed so as to make the delivering company responsible for all defects on a car, matters would then be in a condition where the road which was handling the car would prefer to make the necessary repairs rather than to give its defect card to the connecting road when the car was offered in interchange, and the road receiving a car carrying a defect card would be likely to repair that car at the expense of the delivering road, rather than let the defect continue, with the probability of causing further damage for which it would be responsible.

The most patent objection to this method would be the fact that at present prices it would be in many cases to the advantage of the delivering road to issue its defect card because at present M. C. B. prices it would be probably cheaper to depute the work to some one else rather than to do it themselves. My plan would therefore involve the increasing of the M. C. B. prices to such a level that there would be a profit of 15 or 25 per cent. to the road which made repairs under the rules, on the authority of a defect card. It would then be to the advantage of the delivering road to make the repairs itself, except under special circumstances, and then the road which did the work would profit at the expense of the road which did not repair the defects for which it was responsible.

A feature of this plan would be that roads which borrowed more equipment than they loaned would probably be at a disadvantage, while roads whose borrowing did not exceed their loaning would break even; roads which were loaning more than they borrowed would probably be at somewhat of an advantage, as compared with present practice, and this would not seem to be an undesirable feature.

The only serious disadvantage that I can see in this plan is that there might be a tendency on the part of car owners to neglect the condition of their own equipment, but since they would be responsible to a road to which they should deliver a

car for the defents then existing, it seems that this would correct any tendency in that direction. This is directly in opposition to the present practice under the M. C. B. rules; and I will admit that it would be a pretty drastic change: but it seems that some radical change is about due.

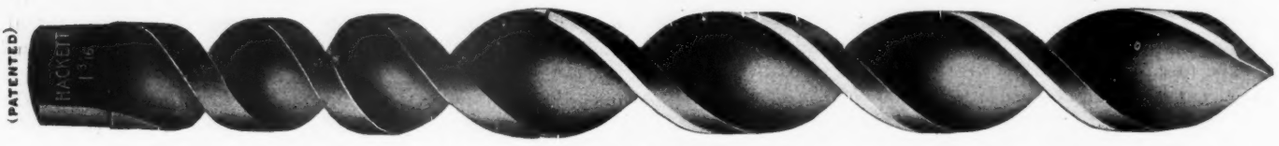
The constant petty changes in the M. C. B. rules, and the innumerable petty and sometimes important questions which are brought up for settlement by the arbitration committee, are leading to the place where it will be practically impossible for a man of not above the general average of intelligence, from the ranks of whom our repairmen and inspectors must be drawn, to devote enough attention to the study of the rules and the arbitration decisions, which supplement and sometimes appear to be at variance with the reading of the rules themselves, and to, at the same time, be a competent "practical" man, able to handle successfully the actual work on the cars.

This tendency is toward greater efficiency, for it is a well tried out principle that greatest efficiency is attained by greatest specialization; but it is not reasonable to expect men to be equally well versed in more than one specialty. I believe that we could expect much more effective and economical work from our inspectors and repairmen if they were relieved of the making of repair cards and all the details which of necessity accompany that work.

I think every one connected with the making of car repair bills, and with their checking when received by the home road, would be interested in a discussion of some rational method of doing away with the work under the M. C. B. rules; which work is gradually, but surely, working toward that undesirable stage popularly known as "red tape."

A. M. Orr.

Greenville, Pa.



HACKETT HIGH SPEED DRILL.

HACKETT HIGH SPEED DRILL.

The Hackett high speed drill is twisted from specially finished bars of high speed steel. The twist, as may be seen from the illustration, extends from the point of the drill to the tang and the shank is therefore of a skeletonized cylindrical form. It is claimed that this design saves 50 per cent. in the weight of the steel used, as compared to an ordinary twist drill. The only machining required is to clean a few ounces of material off the edge of the blank from which the drill is twisted, leaving the skin of the greater part of the forging intact. The dangerous temperature strains, which are responsible for the breakage of so many high speed drills, are practically eliminated because of the uniform section of the drill.

As practically all drill presses, air motors, ratchets, turning and boring machines are equipped for the use of Morse taper shanks it was recognized that the new drill should, if possible, meet these requirements; not only does the skeletonized shank meet all the requirements of the solid taper shank, but it possesses some additional advantages. The principal advantages of the solid taper shank are that a perfect alignment is secured and it permits ease of insertion and removal. The latter point is especially important when it is considered that a high speed drill requires only about fifteen seconds to drill an inch in depth. Changing the drill, even under the most favorable circumstances, may therefore often require several hundred per cent. more time than the actual drilling.

The skeletonized design diffuses the tough, specially hammered surface of the material into the general structure, thus increasing it in stiffness and strength. This design of shank does not allow the strains to become localized, but permits the drill to bend in a manner not unlike a leaf spring, thus preventing the possibility of crystallization, which is the result of local vibrations. The metal in the shank is softer than the rest of the drill and the corkscrew action has a tendency to force it more tightly into its socket, thereby securing a firm fit; there is not the possibility of a loose fit such as sometimes occurs with solid taper shanks which are slightly defective and which often throw all the strain on the tang, twisting it off.

The combination of a tightly fitting shank and a tang of high speed steel of great strength practically eliminates twisting off this portion of the drill with the resultant chewing up of the socket. These drills are manufactured by the Hackett High Speed Drill Company, 90 West street, New York. The drill was designed and patented by George E. Hackett, who was for some time connected with the mechanical engineering department of the Central Railroad of New Jersey, and who has spent three years in developing and testing the drill.

BURNING SHAVINGS IN POWER PLANTS.

With modern coal handling machinery, including mechanical grates and overhead coal bunkers, it is a question whether the shavings are not more bother than they are worth, and we have known cases where it was cheaper to burn coal than to go to the expense of cutting up the old car sills. The planing mill is, and always will be, an inflammable building. The contents are exceedingly liable to catch on fire, and even if the building was fireproof there could be sufficient heat generated by the burning contents of the planing mill to ruin it. This being the case, if it is in close proximity to the power house, the most important building of the whole outfit would be endangered, and this is rendered still more critical by the fact that the fire pumps for fighting the very fire which is dreaded are generally located in the power house, and this would be endangered by its proximity to the planing mill.

The constant speed of tools, which is a characteristic of all woodworking machinery, lends itself particularly to the use of alternating current motors whose non-commutation (and corresponding sparklessness) is particularly valuable in an atmosphere full of sawdust. Alternating current can be distributed at great distances with satisfactory economy, and permits placing this dangerous fire risk at a safe distance from the central power house, and this advantage should not be overlooked. There can be plenty of use made of the shavings from the planing mill by locating a small boiler near by and allowing this to provide steam for the dry kiln, and in the winter time also for heating the planing mill. This will dispose of the troublesome question of handling the shavings, and yet will keep the woodworking department away from the most important building in the whole outfit.—*G. R. Henderson, Canadian Railway Club.*

The Largest Hydraulic Dredge.—The Russian Government has recently received the most powerful dredge ever constructed. It was designed by Lindon W. Bates of New York and all of the electrical equipment was furnished by the General Electric Co. It was built at the Liege Works of the Société John Cockerill. The dredge is in two parts, each half being 216 ft. long, 31½ ft. wide and having a light draught of 4 ft. It is electrically controlled and propelled, each half having a 600 kw. generator driven by a quadruple expansion engine. The whole dredge has a capacity of 7,000 cu. yds. hourly in favorable material. This gives a capacity of 2,000,000 cu. yds. monthly working 10 hours a day.

PERSONALS.

W. M. Saxton has been appointed locomotive foreman of the Grand Trunk Pacific Ry. at Bigger, Sask.

B. J. Peasley has been appointed master mechanic of the Missouri Pacific Ry. at Ferriday, La., succeeding J. Schumacher, transferred.

A. H. Gairns has been appointed master mechanic of the Oregon Short Line at Pocatello, Idaho, succeeding Henry Carrick, assigned to other duties.

E. F. Jones has been appointed acting master mechanic of the Chicago & Western Indiana R. R., in place of P. H. Peck, who has been granted a leave of absence.

C. B. Williams has been appointed general storekeeper of the Central R. R. of New Jersey, with office at Elizabethport, N. J., succeeding W. F. Girten, resigned.

Charles H. Osborn has been appointed assistant superintendent of the car department of the Chicago & Northwestern Ry., with headquarters at the Chicago shops.

J. J. Sullivan, master mechanic of the Louisville & Nashville Ry. at Louisville, Ky., has been transferred as master mechanic to New Decatur, Ala., succeeding H. C. May.

H. C. May, master mechanic of the Louisville & Nashville Ry. at New Decatur, Ala., has been transferred as master mechanic at South Louisville, succeeding W. L. Tracy, resigned.

G. W. Taylor, master mechanic of the Atchison, Topeka & Santa Fé Ry. at Newton, Kan., has been appointed superintendent of motive power of the San Antonio & Aransas Pass Ry., with headquarters at San Antonio, Texas.

George Wagstaff, formerly supervisor of boilers of the New York Central Lines, has entered the service of the American Locomotive Equipment Co., instead of the Railway Materials Co., as announced in the previous issue.

W. L. Tracy, formerly division master mechanic of the Louisville & Nashville Ry. at South Louisville, Ky., has been appointed assistant superintendent of machinery of the Missouri Pacific Ry., with headquarters at Kansas City, Mo.

David Patterson has been appointed master mechanic of the Kansas & Oklahoma division of the Kansas City, Mexico & Orient Ry., and J. S. Hardie has been appointed general foreman of the car department, both with headquarters at Fairview, Okla.

Frank Howard has resigned as general foreman of the car department on the Eastern division of the Wabash R. R. Mr. Howard began railroad work in 1869 on the Missouri, Kansas & Texas Ry., and has been at the head of the car department of the Wabash since 1885.

Peter H. Peck, past president of the American Railway Master Mechanics' Association, member of the arbitration committee, M. C. B. Association, and past president and treasurer of the Western Railway Club, has received a leave of absence from his position as master mechanic of the Chicago & Western Indiana Ry., which practically terminates a term of twenty-one years service with that company.

G. E. Carson, master car builder of the Pittsburg & Lake Erie R. R., at McKees Rocks, Pa., has resigned, to take a similar position with the New York Central & Hudson River R. R., at West Albany, N. Y. Mr. Carson is succeeded by Mr. Samuel Lynn, at present car foreman.

Charles J. D. Donahoe, for many years identified with the motive power department of the Lake Shore & Michigan Southern Ry., and since then secretary to the vice-president of the New York Central Lines at Chicago, has resigned to become secretary to W. H. Marshall, president of the American Locomotive Co.

Adam Bardsley, until recently general master mechanic of the Gulf & Ship Island Railroad, died at his home in Bradford, Pa., on August 19. Mr. Bardsley was a native of England, and began his railroad career in this country in 1873. He occupied successively the positions of master mechanic on the Northern Pacific R. R., master mechanic on the Buffalo, Rochester & Pittsburgh R. R., traveling representative of the American Locomotive Company and general master mechanic of the Gulf & Ship Island R. R. Deceased was sixty years of age.

BOOKS.

American Railway Engineering & Maintenance of Way Association.—Proceedings of the ninth annual convention. Published under the direction of the committee on publications. W. D. Pence, editor, Madison, Wis.

This volume of proceedings includes the complete reports and discussions thereon at the convention held in Chicago last March. In addition to reports there are included the personnel of the different committees, copy of the constitution and by-laws and a list of the members of the association.

How to Build Up Furnace Efficiency. By Joseph W. Hays. Pamphlet size. 44 pages. Published by the author, 601 Hartford Bldg., Chicago, Ill. Price, 50 cents.

The subject of gas analysis and its practical value are not generally understood or appreciated by operating engineers. The author of this pamphlet, who is a practical combustion engineer and has published a number of works on furnace efficiency, recognized this condition and has attempted to fill the void in a very practical treatise, which will be within easy comprehension of the ordinary operating engineer and lead him to improve his furnace efficiency in a scientific manner.

Universal Directory of Railway Officials. 1908 edition. Compiled under the direction of S. Richardson Blundstone, editor of the *Railway Engineer*. Published by the Directory Publishing Company, Ltd., 3 Ludgate Circus Buildings, E. C., London. United States representative, A. Fenton Walker, 143 Liberty street, New York. Price, 10 shillings ($2.50).

This directory is the most complete and valuable work of its kind and presents complete information as to the length of line, gauge, number of locomotives and cars, as well as a directory of all of the officers of every steam railroad in the world. The street railways of the United Kingdom are also included.

CATALOGS

IN WRITING FOR THESE PLEASE MENTION THIS JOURNAL.

"THE WAY TO FORGET" is the title of a very interesting story being issued by the Triumph Electric Company, Baymiller and Sixth streets, Cincinnati.

GIANT TALKS.—The Coburn Trolley Track Mfg. Co., of Holyoke, Mass., publishes monthly a small magazine having the above title. The reading matter carries a conversational tone and serves to illustrate the advantages of this type of trolley track.

METAL WEATHER STRIPS.—The Frost Railway Supply Company, Penobscot Bldg., Detroit, is issuing a small booklet illustrating and describing metal weather strips for railway coaches. These strips keep the dust out of the car and absolutely prevent the windows from rattling.

REVOLVING STEAM SHOVELS.—The Browning Manufacturing Co., Mansfield, O., is issuing a catalog devoted chiefly to illustrations showing the Browning standard steam shovels of the revolving type, which are light in weight and have a very large radius of action. They can also be used as locomotive cranes if desired.

HYDRAULIC PUMPS.—Dean Bros. Steam Pump Works, Indianapolis, Ind., is issuing catalog No. 71, which contains about 40 pages of descriptive matter and illustrations showing hydraulic pumps for all purposes. These pumps can be furnished to deliver pressures as high as 8,000 lbs. per sq. in. Vacuum and compressed air pumps are also being manufactured by this company and are shown in this catalog.

TRIGONOMETRIC SLIDE RULE.—M. J. Eichhorn, electrical engineer, 5759 Aberdeen street, Chicago, has devised a new type of slide rule, which is intended to supplement the present types of rules and has special use in the matter of the solution of triangles, being provided with new graduations for that purpose. A leaflet is being issued giving the principles upon which this rule is based and can be obtained by any one interested.

AUTOGENOUS WELDING.—The Davis-Bournonville Co., West Street Building, New York, is issuing an illustrated catalog on the subject of oxy-acetylene welding and cutting apparatus. The catalog describes in detail the process of cutting and welding, as well as the apparatus in which the gases are generated and combined. Tables of the cost for welding sheets from 1/32 to ½ in. and over and for cutting sheets over 1½ in. are included.

CHICAGO PNEUMATIC DRILL CO.—The advance sheets of Catalog No. 26, covering the section devoted to the Franklin air compressor, is being issued by this company from its general offices in the Fisher Bldg., Chicago. This type of compressor, introduced about eight years ago, has become very popular and new styles and sizes are constantly being added as demand arises for them. The present catalog covers about 100 different styles and sizes.

NEW WESTON ELECTRIC INSTRUMENTS—The Weston Electric Instrument Co., Newark, N. J., is issuing a small leaflet containing a brief preliminary description of new instruments which are now being put on the market. These consist of a new switchboard alternating current ammeter and voltmeter, new portable alternating current ammeter and voltmeter and a new direct current switchboard instrument. The catalog gives the sizes and prices at which each one of these instruments can be furnished.

INDICATORS.—The American Steam Gauge & Valve Mfg. Co., Boston, Mass., is issuing a new catalog on the subject of the American Thompson improved indicator. The catalog is very complete, showing a variety of designs of this type of indicator and also a complete line of attachments and instruments for use in connection with indicators. Full instructions are given for the proper method of taking care of these instruments, attaching them to the engines and how to make diagrams. A number of pages are also devoted to extracts from Hill's Manual on the benefits to be derived from the information ascertained by the use of indicators.

ELECTRICAL MACHINERY.—One of the publications issued by the General Electric Company, Schenectady, N. Y., during the past month is bulletin No. 4617, covering the subject of small size direct connected generating sets. These are driven with steam engines and are furnished in sizes from 2½ to 75 kw. Another publication, which is given the number of 3687, gives a brief history of the material used in transformer construction and is entitled "Transformer Steel." Bulletin No. 4612, which will be of interest to owners of electric automobiles, illustrates and describes a combination ammeter and voltmeter specially designed for that service.

GENERATORS AND MOTORS.—The Northern Electric Mfg. Co., Madison, Wis., is issuing a couple of new bulletins, one devoted to type L engine driven generators, which is numbered 55, and has been compiled to set forth engineering facts in a concise manner and also contains electrical information of a general character that is very interesting. Bulletin No. 56 is on the subject of belted motors and generators which have been on the market for some time and are furnished in a range of sizes and speeds to meet the ordinary requirements. A number of small leaflets are also being issued, among which might be mentioned No. 154 on electric emery grinders.

ELECTRIC MOTOR AND TRAILER TRUCKS.—A pamphlet just issued by the American Locomotive Company, which besides being a catalog of the different designs and types of electric motor, locomotive and trailer trucks for all classes of service, manufactured by the company, contains considerable useful data on electric railway equipment, making it a valuable book of reference for general managers, master mechanics and engineers.

The pamphlet contains 114 pages, the first 57 of which are devoted to illustrations and descriptions of the different standard and special types of electric trucks built by the company. The descriptive matter gives briefly the characteristic features of each different type and in the majority of instances each truck is illustrated by reproductions from photographs showing the side and perspective views and also by an assembled drawing giving the principal dimensions, weights and other important data. Then follow illustrations of a few cars equipped with the company's trucks, the principal data for the car illustrated being given under each view. The remainder of the pamphlet is devoted to illustrations and data, conveniently arranged, on electric railway equipment. In this chapter are included the standards adopted by the American Street & Interurban Railway Engineering Association; illustrations together with tables of weights of different makes of electric truck journal boxes; illustrations and table of capacities of ball-bearing center and side bearings for electric trucks; illustrations showing different styles of tire fastenings, sections and tables of weights of cast iron, steel tired, rolled steel and solid forged truck wheels; principal dimensions of street railway motors manufactured by the General Electric Company and Westinghouse Electric & Manufacturing Company; data on air brake equipment manufactured by General Electric Company, Westinghouse Traction Brake Company and National Brake & Electric Company; a table of data relative to standard car equipment of electric railways in the United States and Canada; a table of location of third rails; a list of names of the parts of an interurban combination passenger and baggage car manufactured by the Jewett Car Company; a table of dimensions and weights of car bodies manufactured by the Cincinnati Car Company; a list of names of all parts of the American Locomotive Company's standard Type A high speed truck and material specifications.

NOTES.

CROCKER-WHEELER COMPANY.—A new office of this company has been opened in the Gumbel Building, Kansas City, Mo. It will be in charge of A. W. Payne.

WM. J. SMITH & CO.—Messrs. Fred Ward & Son, First and Howard streets, San Francisco, Cal., have been appointed Pacific coast agents of the above company, whose main office is in New Haven, Conn.

LATROBE STEEL COUPLER CO.—John Havron has resigned as president of the Rogers Locomotive Works to take a position as western representative of the above company. His office will be in the Old Colony Building, Chicago.

BALDWIN LOCOMOTIVE WORKS.—Lawford H. Fry, technical representative of the Baldwin Locomotive Works in Europe, is transferring his headquarters from London to Paris, where he is opening an office at 56 Boulevard Haussmann.

AMERICAN SPECIALTY COMPANY.—H L. Mills, formerly in the sales department of the Whiting Foundry Equipment Company, has resigned to accept the presidency of the American Specialty Company, 1440 Monadnock Bldg., Chicago, which is marketing the "Use-Em-Up" drill sockets.

S. F. BOWSER & CO.—Frank T. Hyndman, formerly mechanical superintendent of the N. Y., N. H. & H. R. R., has been appointed eastern railroad representative of the above company. Mr. Hyndman takes the place of Wm. A. Pitcher, who met his death in the Aveline Hotel fire at Fort Wayne, Ind., last May.

BETTENDORF AXLE COMPANY.—This company announces that its rapidly increasing business is compelling an extension of its plant and machinery equipment at Bettendorf, a suburb of Davenport, Ia. Several years ago it obtained sufficient space to enable it to manufacture all classes of railway equipment, including the building of complete railway cars.

CUTLER-HAMMER MFG. CO.—Announcement is made by the National Battery Company, of Buffalo, that the receivership under which it has been operating since last November was terminated on August 19. The full control of the reorganized company has been secured by the Cutler-Hammer Mfg. Co. of Milwaukee, Wis. The plant in Buffalo will continue to be operated as heretofore.

LOCOMOTIVE APPLIANCE COMPANY.—At the first regular meeting of the board of directors of the above company the following officers were elected: C. A. Thompson, president; Ira B. Kegler, 1st vice-president; H. S. Gray, 2nd vice-president; Willis C. Squire, 3rd vice-president and treasurer; W. H. England, secretary and assistant treasurer, and E. H. Allfree, mechanical engineer.

ANNUAL REPORT OF THE AMERICAN LOCOMOTIVE COMPANY.—The seventh annual report of the directors of the American Locomotive Company, which gives the financial condition of the company for the year ending June 30, 1908, is being issued. It shows that there was a decrease of over twelve million dollars in the gross and over one and three-quarter million dollars in the net earnings of the company for the year.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The season of professional meetings of the A. S. M. E. will be opened on Tuesday evening, October 13, by a meeting of the Gas Power section in the Engineering Societies Building, New York. Two papers will be read, one by E. A. Harvey on "Gas Producer Plants," containing data of costs, performances, etc., and one by N. T. Harrington, giving results of tests of producer plants.

ADREON MFG. CO.—This company, whose home office will be in the Security Building, St. Louis, and Chicago office at 300 Western Union Building, has been organized for the purpose of manufacturing and selling railway supplies. It will represent in the southwest the following companies: American Brake Shoe & Foundry Company; Steel Car Forge Company; Pittsburgh Lamp Brass & Glass Company; Acme Pipe Clamp Co., and will also manufacture on its own account several railway specialties. The organizers of this company are E. L. Adreon, Jr., D. R. Neiderlander and Wm. Miller.

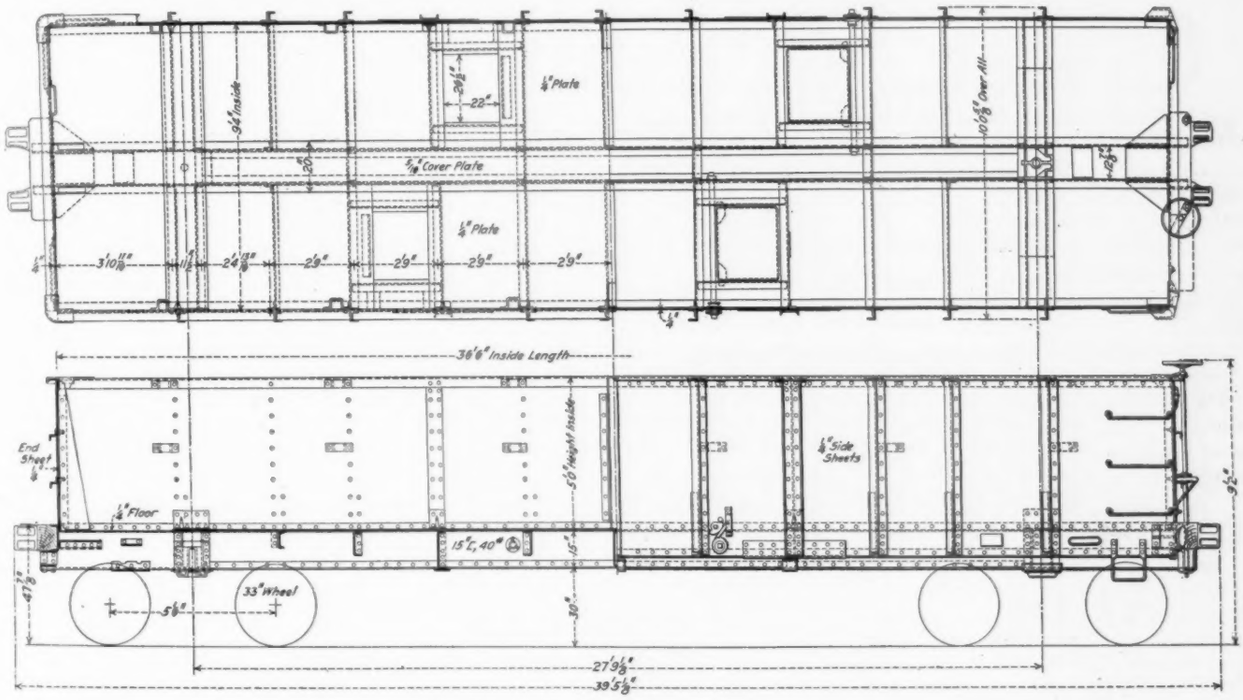
STANDARD FIFTY TON GONDOLA COAL CAR.

VIRGINIAN RAILWAY.

The Virginian Railway extends from the coal fields of West Virginia to tidewater and has been constructed throughout with the idea of hauling trains of very heavy tonnage. The rated train load over the line will be 80 loaded cars or about 6,000 tons behind the locomotive. This road differs from most other American railways in the fact that there will be comparatively little interchange traffic and the equipment can be designed for the service desired with the assurance that it will always be available. This service, in the case of the coal cars, will be very severe, for, in addition to the heavy rated train load, the unloading will be by Hewlett unloading machines, in which the car is clamped in a framework and turned over bodily. This is severe treatment and cars to stand up under it must be specially designed with this service in view. It is with all of these points in mind that the car illustrated herewith has been designed. The designer was not hampered by restriction as to clearance or rules of

The body bolster consists of two diaphragms on each side of the center sills, set back to back, each formed of a 5/16 in. plate with a flange 3¼ in. wide all the way around. These diaphragms are flanged to fit the center and side sills to which they are securely riveted. The cover plate consists of the ¼ in. floor plate and a 7/16 x 16 in. plate above this, both of which are securely riveted to the flanges of the diaphragms. There is a ½ x 16 in. bottom cover plate extending continuous below the center sills to a point just beyond the side bearings. A cast steel center casting fits between the center sills and is held by four of the same rivets securing each diaphragm to the sills. A flanged 5/16 in. plate, 4½ in. deep, forms a backing and stiffener between the diaphragms just above the side bearings.

Between the bolsters there are three single deep diaphragms, between the side and center sills on each side of the same size and shape as at the bolster; also four flanged intermediate cross



FIFTY-TON STANDARD GONDOLA COAL CAR—VIRGINIAN RAILWAY.

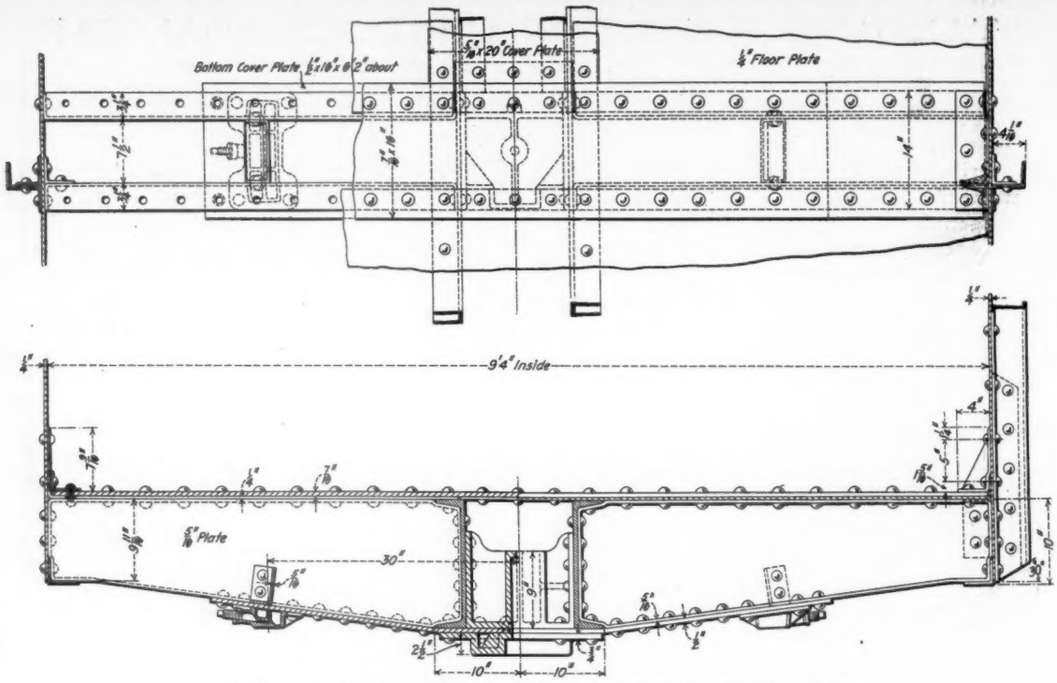
other systems and has developed a construction which in many respects is novel and admirable.

Although the unloading is normally to be done by machines it was deemed advisable to furnish four small bottom doors, which close flush with the floor, for use on the ordinary type of coal pockets. These doors are arranged two on either side and staggered as shown in the plan.

Considering the details of the design, and referring to the accompanying illustrations, it will be seen that the center sills consist of two 15 in., 40 lb., channels set back to back, about 13 in. apart and extending continuous for the full length of the car. These are reinforced between the bolsters by a 3½ x 3 in., 6.6 lb., angle riveted opposite the lower flanges and a 20 x 5/16 in. top cover plate also extending between the bolsters. The side sills consist of a 10 in. built up channel, the web of which is formed by the extension of the ¼ in. side plates, the lower flange by a 3 x 3½ in., 6.6 lb., angle and the upper flange by the ¼ in. floor plate, which is flanged upward 2⅞ in. and riveted to the side sheets. This built up structure is stiffened by the side posts which extend to the bottom of the side sheets, being spaced about 2 ft. 9 in. apart.

bearers and two channel iron cross bearers. The construction at the deep diaphragm cross bearers is the same as at the bolster, except that there is no cover plate at the top, the diaphragm simply being riveted to the floor sheets and no filling piece between the center sills. The shallow diaphragms, which are shown in one of the details, are flanged in the same way as the deep ones to fit around the side sills and to the upper part of the center sills. There are flanged filling pieces between the center sills at these points. The two channel iron cross bearers are located nearest to the bolster and consist simply of 6 in., 8 lb., channels secured with angle irons to the side and center sills and riveted to the floor sheet.

The side posts are of 4 in., 10.3 lb., Z bars, reinforced by a 3 x 3½ in. angle for about 2 ft. up from the bottom. The side sheets, of ¼ in. steel, are in three sections on each side, the join being covered by a 7 in., 12¼ lb., channel, which takes the place of the side post at these points. The channel side posts come opposite the deep diaphragm cross bearers. The sides are 5 ft. high inside and are capped with a special shaped bulb angle, a section of which is shown in one of the illustrations. At the corners angle irons form the posts and the end and side bulb

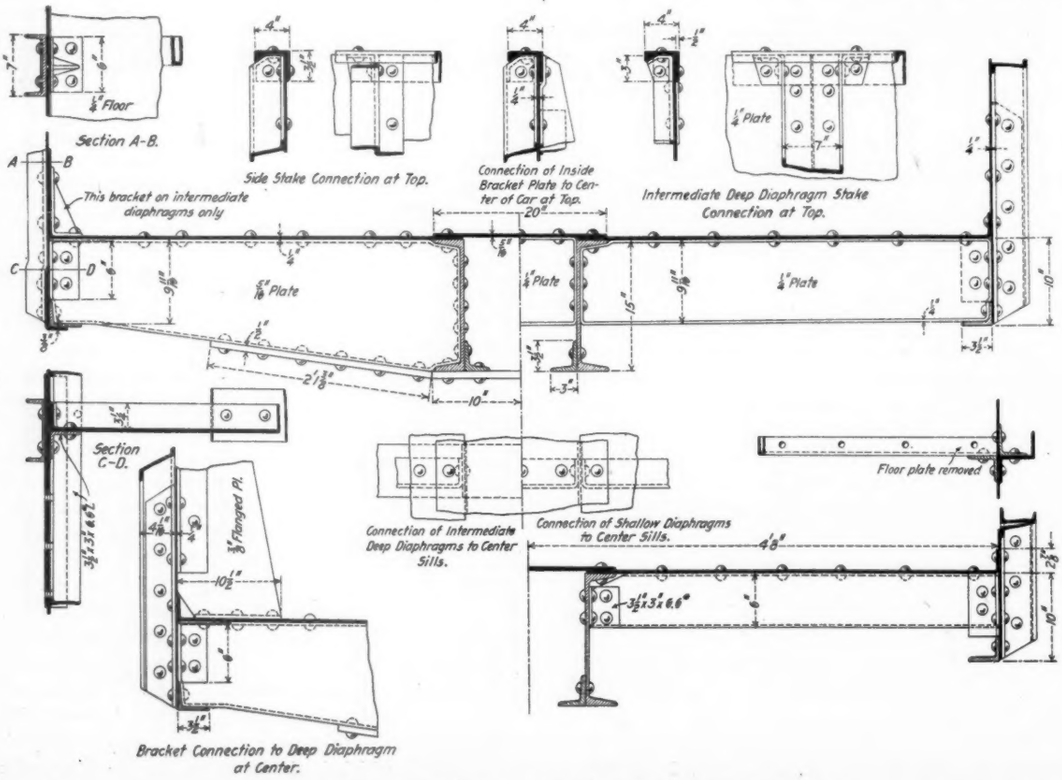


DETAIL OF BOLSTER—VIRGINIAN RAILWAY STANDARD GONDOLA CAR.

angles are connected by a casting. Inside the body at the center post is a stiffener formed of a ⅜ in. flanged steel plate which has a bearing of 10½ in. at the bottom and extends nearly to the top of the sides. Pockets are secured on the inside, opposite the posts, for the insertion of stakes when the car is used for carrying lumber.

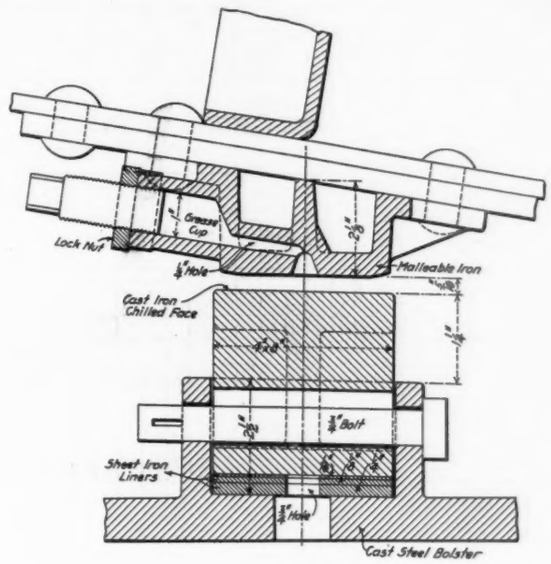
The end construction consists of ¼ in. plates stiffened by two horizontal Z bars and by vertical stiffeners on the inside, one over each center sill, of the same shape and construction as is used in the center of the side sheets.

The most careful attention has been given in this car to the matter of draft rigging and its attachments. The details at this point are shown in one of the illustrations and it will be seen that the end sill, which consists of a 10 in. channel, extends nearly 3 in. above the floor level and is secured to the flanged edge of the ¼ in. floor sheet as well as the end sheet. The center sill is cut away to clear the end sill, which gives a clearance of 7⅞ in. above the bottom of the center sill for the passage of the coupler shank. A pressed steel gusset plate fits between the center sills and backs up the lower edge of the end sill and similar plates are provided outside of the center sills, extending nearly to the end of the wooden buffing block. A ½ x 7 in. sheet is pressed into a U shape and fits between the center sills at the end stiffening them and forming a support for the wooden buffing block. Since the type of draft gear has not yet been decided upon, the location and construction of the follower stop castings are not given. The construction is such as to give the coupler a 1¾ in. side clearance at the end of the pocket.



GENERAL DETAILS—VIRGINIAN RAILWAY STANDARD GONDOLA CAR.

The use of a buffer block is not new, but its arrangement in this case is somewhat novel. The iron blocks, or buffers, are rounded only on the outer half, the inner section being flat, and are backed up by an 8 x 10 in. oak block, which bears directly against the end sill. Experiments in a testing machine indicated that an oak block 8 in. thick could be compressed for 1 in. and would recover, giving a diagram which was practically ideal for a friction draft gear. Thus after the buffer comes into contact it is estimated that the cushioning effect of this block for a distance of 1 in. on each car will simply increase the draft gear capacity for that distance. (This subject was discussed by Mr. R. P. C. Sanderson at the May meeting of the New York Railroad Club.)



SIDE BEARING DETAIL.

The construction of the center plate and side bearings is shown in the illustration. Particular attention is drawn to the provision for lubrication in both of these places. The side bearing on the truck is of cast iron with a chilled face and is held in place by a cottered bolt. Cast iron liners of varying thickness are fitted in the bottom of the pocket and permit adjustment for the proper clearance.

The truck is of the regular arch bar type of somewhat heavier construction than usual. It has cast steel bolsters with the center plate riveted on. Special arrangements are required in this truck because of the fact that the cars will be hauled up an incline by means of a cable in the center of the track, which compels the location of the brake beams at a higher point than usual and necessitates the use of a special construction for preventing the tilting of the beam. This consists of a hanger secured to the inside flange of the beam and carried from a spring brass support secured to the sand plank. In other respects the truck is heavy standard practice.

This car was designed by Mr R. P. C. Sanderson, superintendent of motive power of the Virginian Railroad.

INDUSTRIAL EDUCATION.—The National Society for the Promotion of Industrial Education will hold its annual meeting at Atlanta, Ga., November 19, 20 and 21. This meeting will be addressed by the most prominent educators and representatives of industrial interests in the country. An exhibition of trade school work from all parts of the U. S. will be one of the features of the convention.

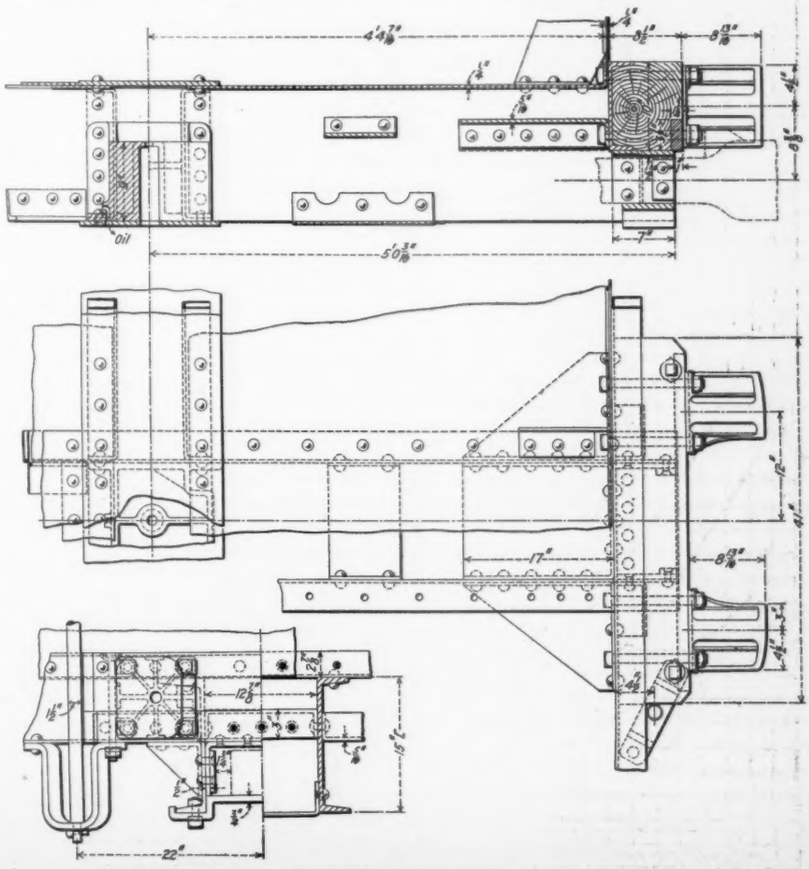
RAILWAY OFFICIALS AND EMPLOYEES ORGANIZE.

A meeting was recently held in Chicago which resulted in the formation of an organization, known as the American Railroad Employees' and Investors' Association, composed of railway officials and employees. The officials of the leading roads and of the leading brotherhoods were identified with the founding of the organization and participated in the initial meeting.

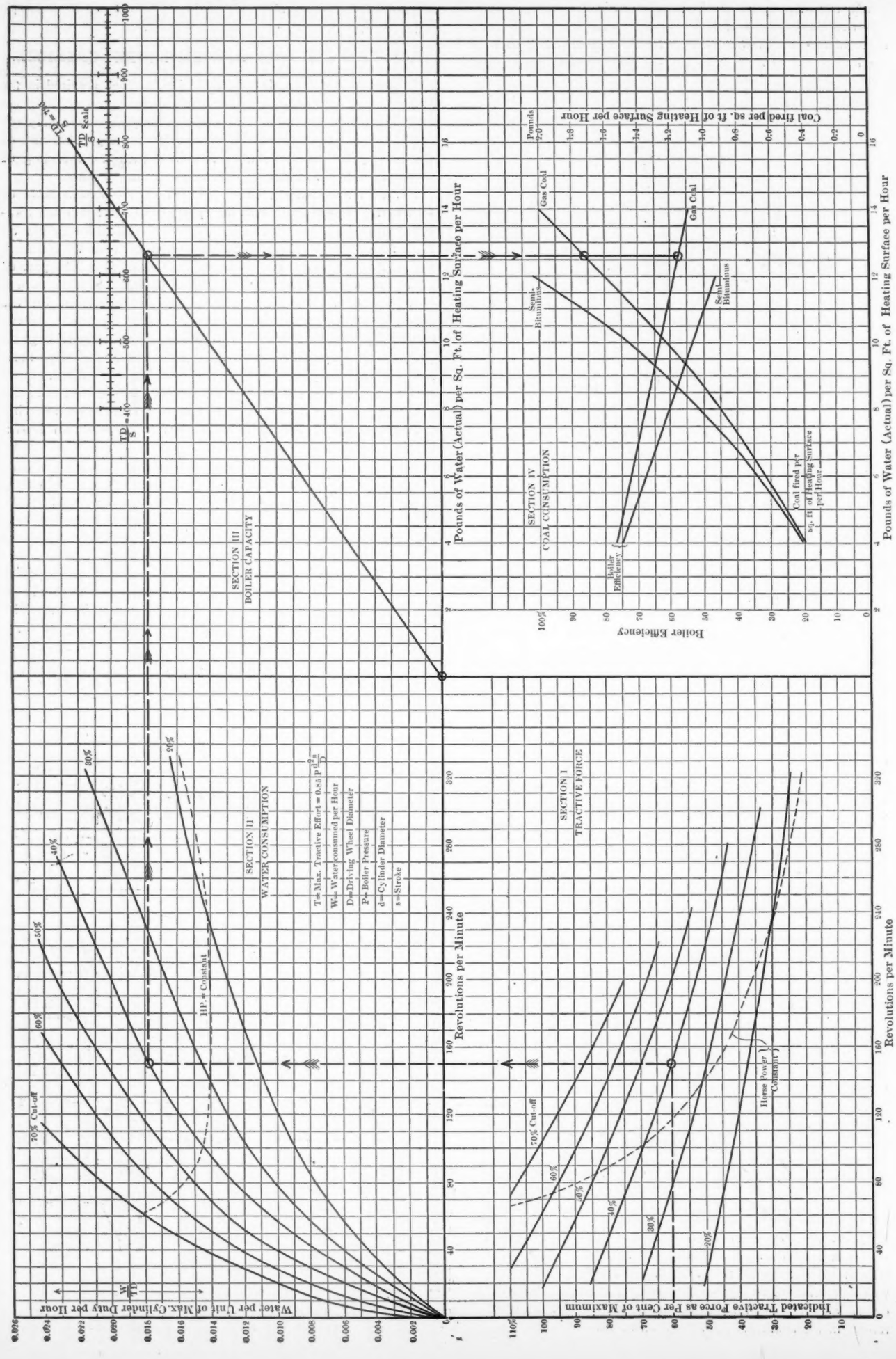
Mr. P. H. Morrissey, Grand Master of the Brotherhood of Railroad Trainmen, said that the "purpose of the American Railroad Employees' and Investors' Association shall be to use all lawful methods to cultivate and maintain between its members such a spirit of mutual interest and such concern on the part of all for the welfare and prosperity of American railroads as will best promote their successful and profitable operation for the benefit alike of their employees, investors and the public; to encourage by every proper method, cordial and friendly feelings on the part of the public toward American railroads and their business; to publicly provide means and methods for obtaining consideration and hearing from all legislative bodies and commissions empowered to enact laws, rules and regulations affecting the conduct and operation of railroads; to do whatever lawful things may be necessary in order to secure a fair return alike to capital and to labor interested in American railroads with due regard at all times to efficient service, fair treatment and safety to the public. This association shall at no time be used for partisan political purposes, nor shall it take any part in any controversy which may arise between railroad employees and road officials.

Mr. P. H. Morrissey was elected president and will appoint the secretary. Mr. Morrissey will resign his office in the B. of R. T. and devote his whole time to the new organization. The following were elected as an executive committee: A. J. Earling, E. P. Ripley, George B. Harris, B. L. Winchell, P. H. Morrissey, Warren S. Stone, E. B. Garretson and John J. Hanrahan.

The office of the association will be at 233 Railway Exchange, Chicago.



DETAIL AT END OF UNDERFRAME—VIRGINIAN RY. GONDOLA CAR.


SECTION I
TRACTIVE FORCE
SECTION II
WATER CONSUMPTION
SECTION III
BOILER CAPACITY
SECTION IV
COAL CONSUMPTION
Indicated Tractive Force as Per Cent of Maximum
Revolutions per Minute
Water per Unit of Max. Cylinder Duty per Hour
Pounds of Water (Actual) per Sq. Ft. of Heating Surface per Hour
Boiler Efficiency
Coal fired per sq. ft of Heating Surface per Hour
Horse Power Constant
HP. = Constant
T = Max. Tractive Effort = 0.85 P d² s / D
W = Water consumed per Hour
D = Driving Wheel Diameter
P = Boiler Pressure
d = Cylinder Diameter
s = Stroke
Gas Coal
Semi-Bituminus
Boiler Efficiency
Coal fired per sq. ft of Heating Surface per Hour

LOCOMOTIVE CHARACTERISTICS.

By Lawford H. Fry.

In the American Engineer of October, 1907, the writer described a method of plotting characteristic curves for a locomotive so as to present a single diagram to show the relations existing between the speed, the tractive force, the water consumption and the boiler efficiency; in fact, to chart the whole economy of the locomotive. The chart published last year was applicable only to a compound locomotive; in the present article the method is extended and a chart is given for the operation of single expansion locomotives.

As will be seen, the diagram is divided into four sections, applying respectively to (I) Tractive Force, (II) Water Consumption, (III) Boiler Capacity, and (IV) Coal Consumption.

Section I comprises a series of curves which show the relation between the indicated tractive force, the point of cut-off and the speed. The curves have been drawn for various degrees of expansions with the speeds for the ordinates, and for the abscissæ, the values of the indicated tractive force expressed as percentages of the maximum effective tractive force. This maximum tractive force, by which the indicated tractive forces are measured, is that given by the usual formula $T = 0.85\ P\frac{d^2s}{D}$, where P is the boiler pressure in pounds per square inch, d and s are respectively the cylinder diameter and stroke, and D is the driving wheel diameter in inches. By thus expressing the indicated tractive force as a percentage, and not on an absolute scale, the curves can be used to give results applicable to any normal locomotive, irrespective of its size, the actual tractive force in each case being found by multiplying the percentage by the value of T for the particular locomotive in question. The maximum effective tractive force, as given by the formula above, has been chosen as a convenient basis of measurement, but it is to be noted that it is not the maximum indicated tractive force, but is the effective force calculated by allowing 8 per cent. for machine friction and an assumed maximum mean effective pressure of 92 per cent. of the boiler pressure; as a consequence the indicated tractive force at the longer cut-offs and slow speeds is more than 100 per cent. of T.

For an example of the practical working of the chart, consider a locomotive with cylinders 20 x 26 in., with 74 in. driving wheels and a boiler pressure of 200 pounds. T = 24,000 pounds, and the curves in Section I show that if running at 150 revolutions per minute, with a cut-off of 40 per cent., the indicated tractive force will be 60 per cent. of T; that is, 14,400 pounds.

Section II contains a series of curves which give the steam consumption for any combination of speed and cut-off. These curves, like those in Section I, are adapted for general application irrespective of the dimensions of the engine under consideration, and for this reason the reading on the ordinate scale does not give the hourly water consumption direct, but gives a factor proportional to the water consumed per hour, and from which the actual weight of water is found by multiplying by T D where T is the maximum effective tractive force as above and D is the driving wheel diameter.

The curves in sections I and II are placed in such a relation to each other, that having found the tractive force corresponding to the given conditions from Section I, it is only necessary to draw a vertical through the point thus found up to the water curve in Section II for the cut-off at which the locomotive is to work. For instance, if we continue with the example commenced above, by drawing a vertical up the line of 150 revolutions, to meet the curve for 40 per cent. cut-off in Section II, the water factor is found to be 0.0176. This multiplied by T = 24,000 and by D = 74, gives an hourly steam consumption of W = 31,250 pounds.

In Section III the diagonal line serves to multiply the water factor $\frac{W}{T\ D}$ by the factor $\frac{T\ D}{S}$ where S is the heating surface in square feet, giving as a product $\frac{W}{S}$, that is, the water consumed per square foot of heating surface per hour. The factor $\frac{T\ D}{S}$, or as it is sometimes written, B D, is the maximum tractive effort multiplied by the driving wheel diameter and divided by the heating surface, and is a factor commonly used in the comparison of locomotives. In Section III a scale is provided so that for a locomotive having for $\frac{T\ D}{S}$ any value between 400 and 1,000, the proper diagonal can be drawn. The line shown in the figure is applicable to a locomotive having the cylinder dimensions examined in Sections I and II and a heating surface of 2,470 square feet, so that $\frac{T\ D}{S} = \frac{24,000 \times 74}{2,470} = 720$. The diagonal is accordingly drawn from the origin through the point 720 on the scale. It was found above that under the conditions assumed the steam consumption factor was 0.0176, and by drawing a horizontal at this height to meet the diagonal and from their point of intersection dropping a perpendicular, the water consumption is found, from the scale between Sections III and IV, to be 12.6 pounds per square foot of heating surface. It is to be noted that this figure is arrived at by taking the actual water consumption of the cylinders, not the equivalent evaporation from and at 212 degrees, and the heating surface is measured on the water side of the tubes in accordance with the usual American practice.

Now, if we have sufficient information regarding the type of boiler and the class of fuel used, we can set up a relation between the rate of evaporation per square foot of heating surface, and the boiler efficiency, and the rate of coal consumption. Two sets of curves for this purpose are plotted in Section IV. These curves are derived from tests of the boilers of the Pennsylvania Railroad Atlantic type engines, and of the two sets of curves that for the semi-bituminous coal is from the tests described by the committee of the Master Mechanics' Association in their report on Balanced Compound Locomotives, while the set of curves for the bituminous gas coal is from the tests described in the paper by the writer read before the Institution of Mechanical Engineers, in April of this year.* It will be noticed that the gas coal gives the higher efficiency and a greater capacity—14 as against 12 pounds of water per square foot of heating surface. From these curves it is a simple matter to read off the boiler efficiency and the rate of firing per square foot of heating surface, while the weight of coal per square foot of heating surface per hour multiplied by the heating surface gives the total coal consumption per hour. Continuing the example already begun, we find from the curves in Section IV a boiler efficiency of 57 per cent. and a coal consumption of 1.72 pounds per square foot of heating surface, which gives a total of 1.72 x 2,470 = 4,250 pounds per hour with gas coal as fuel.

From the foregoing it is obvious that the coal and water consumption for a given locomotive under given service conditions are very readily found from the curves. In the chart the scales for the curves are marked in percentages and factors, so that they are of general application, but for any given locomotive a chart can be drawn with the speeds in miles per hour, the tractive forces in pounds, and the total water and coal consumption in pounds per hour. In either form the curves should be of considerable service in determining the dimensions to be required by a locomotive for a given service, or in studying the question of tonnage rating for an existing engine.

To those interested in carrying out calculations regarding the economy of the locomotive it will be clear that the curves given carry considerably more information than that which they are designed to give by a direct reading. For example, if we desig-

* See American Engineer, May, 1908, page 186.

nate the indicated tractive force at any speed by T, the indicated horse power is $\frac{T_1 \times V}{375}$ where V is the speed in miles per hour, and since $V = \frac{n D}{336}$ where n is the number of revolutions per minute and D the driving wheel diameter in inches, if we designate the indicated horse power by H_1 we have

$$H_1 = \frac{T_1 n D}{126{,}000} \quad \ldots\ldots\ldots\

A RATIONAL SYSTEM OF NUMBERING.

BY C. J. MORRISON.*

From the earliest ages it has been customary when one of any article was secured to assign to it the digit, or symbol, representing the first unit of the numbering system, and if another was obtained, to assign the second number, and so on. Thus, if a merchant has one wagon it is No. 1, and if he enlarges his business and gets another wagon, it is No. 2. Such a system may be all right for this purpose, but falls far short of answering the real needs when applied to numbering machines in a shop, or locomotives on the road. Yet such a system is used largely in numbering the locomotives, and almost universally in numbering machines. It is easily possible in a shop of ordinary size, by using four figures in the number of each machine, to make the numbers show the class of machine and its location. In a shop of unusually large size it may be necessary to use five figures in the numbers for machines in certain positions of the shop.

The system that has been used in one large shop for the past three years is as follows: The first two figures of the number show the class of machine, *i.e.*, lathe, planer, shaper, saw, etc., while the last two or three figures show the shop in which the machine is located. As the numbers advance from the south in shops running north and south, and from the west in shops running east and west, the number also gives a close approximation to the position in the shop. For example, 0465 is a lathe in the east machine shop, while 0415 is a lathe in the tool room. When five figures are used the machines in a shop of almost unlimited proportions can be numbered. The complete system for a very large shop is as shown below. Four figures are used in the machine shop proper, while five figures are used in all the other shops.

CLASSES OF MACHINES.

No. of Class.	Machine.
00	Bolt Cutters
01	Planers
02	Shapers
03	Milling Machines
04	Lathes
05	Vertical Boring and Turning Mills
06	Drill Presses
07	Abrasive Wheels
08	Miscellaneous Machines, (such as Cock Grinders, Triple Valve Grinders, etc.)
09	Quartering Machines
10	Wheel Presses
11	Gear Cutters
12	Horizontal Boring Mills
13	Wheel Lathes
14	Slotters
15	Nut Facers
16	Centering Machines
17	Special Tin Shop Machines
18	Special Belting Machines
19	Pipe Machines
20	Presses
21	Oil Separators
22	Nut Tappers
23	Motors, Electric
24	Motors, Air
25	Bolt Turning Machines
26 to 30	Vacant for New Machines
31	Rattlers
32	Punches and Shears
33	Rolls
34	Flue Cutters
35	Flue Welders
36	Saws
37	Riveters
38	Stay Bolt Finishers
39	Blowers
40	Clamps
41	Forges
42	Furnaces
43	Steam Hammers
44	Stationary Air Hammers for Welding
45	Bolt Headers
46	Bull Dozers
47	Forging Machines
48	Spring Making Machinery
49	Gainers
50	Universal Wood Workers
51	Mortisers
52	Matchers
53	Tenoners
54	Buffers
55	Plating Machinery
56	Hair Pickers
57	Jammers
58	Air Hose Coupling Machines
59	Air Hose Splicing and Extracting Machines
60	Transfer Tables
61	Cranes

* Standardizing Engineer, A. T. & S. F. Ry. System.

ASSIGNMENT OF NUMBERS FOR DIFFERENT SHOPS.

No.	Shop.
	MACHINE SHOP PROPER.
00 to 19	Tool Room
20 to 49	Brass Room
50 to 59	Air Room
60 to 64	West Machine Shop
65 to 99	East Machine Shop
	OTHER SHOPS.
100 to 150	Boiler Shop
151 to 199	Water Service
200 to 250	West Wheel Shop
251 to 299	Pattern Shop
300 to 350	Cabinet Shop
351 to 399	West Car Shop
400 to 499	Blacksmith Shop
500 to 550	West Planing Mill
551 to 599	East Wheel Shop
600 to 650	East Planing Mill
651 to 699	East Car Shop
700 to 750	Steel Car Shop
751 to 999	Vacant for Extensions
Example:—	
0115	Planer in Tool Room
0163	Planer in West Machine Shop
0175	Planer in East Machine Shop
01156	Planer in Water Service
01501	Planer in West Planing Mill
01675	Planer in East Planing Mill

The same system may be applied to numbering locomotives with equally good results. On a large system, composed of a combination of small roads, by using four figures in each number, the road upon which the locomotive is running and the class of engine can be shown. Thus, the first figure could be used to designate the road and the last three figures the class of locomotive. Example:

All locomotives with the first figure 0 mean A. B. C. Ry.;
" " " " " " 1 " H. R. T. Ry.;
" " " " " " 2 " X. N. Y. Ry.;
" " " " " " 3 " W. K. S. Ry.;
All locomotives with the second figure 1 are eight wheelers.
" " " " " " 2 are moguls.
" " " " second figure 3 are ten wheelers.
" " " " last two figures 01 to 50 are simple.
" " " " " " " 51 to 99 are compound.
And so on.

Thus, locomotive 0101 is an eight wheeler on the A. B. C. Ry., while 1101 is an eight wheeler on the H. R. T. Ry.; 0310 is a ten wheel simple locomotive on the A. B. C. Ry., while 0355 is a ten wheel compound on the same road. Although the system may at first seem a little complicated, it is really very simple and easy to learn. By the use of a fifth figure considerable additional information, such as size of wheels, weight, etc., may be shown. However, it hardly seems advisable to use a fifth figure in the case of locomotives. On systems where it is not necessary to show the roads on which the locomotive is running, the figures may be used to show weight, tractive effort, or similar information.

With reference to the machines, this system has proved very valuable when extended to all of the shops on a large railroad system. Everyone soon became familiar with the symbols, so that when a master mechanic referred to machine 0463, everyone knew he referred to a lathe. Telegraphic reports, requests for repair parts, etc., needed to only quote the number to give all required information.

One of the most useful applications of the system was the numbering of schedules for work. By numbering the schedules on the same system as the machines, the machine upon which the work was to be done was immediately shown.

The system does not need to end with the numbering of machines, schedules and locomotives, but may be extended to the employees, shop orders, general instructions, and, in fact, to any collection of objects, information or persons requiring numbers.

COMBINED RECIPROCATING AND TURBINE ENGINES IN STEAMSHIP.—The Dominion liner "Laurentic," which was recently launched at Belfast, is of special interest on account of the adoption in this vessel of a combination of reciprocating engines with a low pressure turbine. The vessel is tripled screwed, each of the wing propellers being driven by a four-cylinder triple expansion engine and the center propeller by a turbine. In this way the economic advantage of complete expansion of the steam is obtained and the necessity for separate turbines for astern movement is eliminated. The "Laurentic" is 565 feet long, 67 ft. 4 in. beam and has a gross tonnage of 14,500. She will be used in the Canada trade.

STEEL PASSENGER EQUIPMENT.*

ARRANGEMENT OF UNDERFRAME.—FORM III.

BY CHAS. E. BARBA AND MARVIN SINGER.

Of the three general methods of load carrying by the underframe, the first two have been discussed in previous chapters.† They comprise:

Form I, which carries the load upon the side girder and opposes a nominal center sill section to end shocks.

Form II carries the whole load upon the center sills, which are of a large sectional area to oppose end shocks.

Form III, the basis of this article, is really a combination of both the other forms—carrying load upon side, center and intermediate sills, if any, and endeavoring to oppose all of them to end shock. The report of the last M. C. B. Association committee upon this topic recognizes the same underframe forms we have analyzed, and, speaking of the third form, says: "Third: That in which the center and side rails with truss rods and the general construction of wooden cars is reproduced in metal. The Southern Pacific car may be given as an example of this class."

The previous articles contain references to this form of underframe—upon page 461, December, 1907, as follows: "The third form is characteristic of a majority of all the equipment now in use. Herein all sills carry loads to a bolster." The previous page of the same issue shows this form diagrammatically.

PROMINENT EXAMPLES OF THIS FORM IN STEEL.

Of cars illustrating this type with underframes widely differing from one another in detail construction, may be mentioned:

(1) The composite car for the Illinois Central R. R. (1903) which used 9" 21 lb. I-beams for center and side sills. The whole floor was covered with a ¼" plate and four 1¼" truss rods were used.

(2) The first car built for the Interborough Rapid Transit Co. in 1904 used a composite underframe of wood and steel with 1¼" truss rods. The center sills were composed of 2-5" 12.25 lb. I-beams, each sandwiched between 5" x 8" wooden stringers. The side sills were of 6" 8 lb. channels with a 3¼" x 6" stringer outside and a 3¼" x 7" stringer inside. The future of this car is of note in that the center sills were later changed to built up I-sections from 5" Z and 2-4" x 4" angles, while the side sill was reduced to a 5" x 3" angle. The latest type now uses 6" 17.25 lb. I for the center sills. Flitched or sandwiched beams have thus been relegated.

(3) The car designed by Mr. G. I. King for the M. C. B. convention of 1904. This car uses two 1¾" truss rods, a box girder center sill with a 24" x ½" top cover plate, 12" 25 lb. channels, with their bottom flange reinforced by a 1" x 6" plate. The bottom being double latticed. The side girder consisting of ¼" steel plate, 41⅜" deep, reinforced at the top by 2½" x 2½" x ½" angle and the bottom by a 3" x 3" x ½" angle.

(4) The Pressed Steel Car Co. exhibited a car built for the Southern Ry. at the 1906 M. C. B. convention, in which the center sills were built up, channel section, with a 21½" x ¼" top cover plate. The web of channel being of ⅜" plate 22" deep at the center and 13⅛" over the truck centers, reinforced top and bottom with 3½" x 3½" x ½" angles. The side girder was composed of 0.3" plates 36" deep, with a 5" x 3" x ½" side sill angle.

(5) The Santa Fe (1905) steel underframe shows no side girder, both center and side sills being fishbellied of built up construction. The center sill was similar to the construction of the Southern, but of the following dimensions:

Top cover plate	24" x ¼"
Web	24" x 5/16"
Angles	3" x 3" x ¼" (1 per web top)
Angles	3" x 3" x ¼" (2 per web bottom)

The side girder was of 5/16" plate 23" deep, two 3" x 3" x ⅝" bottom angles and 4" x 3" x 5/16" top angle and a 3" Z supporting a nailing sill of wood 3⅜" x 5".

(6) The Southern and Union Pacific Lines use two 1½" truss rods with 12" 31.5 lb. I for the center sills and a 3½" x 7" x ½" side sill angle at the bottom of the deep side girder.

(7) The C. I. & L. combined car shows two 1½" truss rods with sandwiched 8" 18 lb. I-beams, with a 7" x 8" wooden beam for center sills and 6½" for side sills.

These cars vary so much in area for the various members and in load carrying imposed upon them that general remarks cannot be made to fit each case. However, the maximum center sill area provided for in any of them is 31 sq. in. (not including the proposed car of Mr. King), which will give a direct stress of 12,900 lbs. per sq. in. for end shock alone. This stress, however, does not include the effect of eccentric action of end load nor the strain of lading, which would undoubtedly cause all of these cars to lie outside of the recommendations of the Master Car Builders' Association.

In reference to the cars with flitched stringers or sandwiched beams, it may be noted that one of the largest systems has in its experience pronounced them a failure and at one time had its yards piled full of beams which were not used as intended because the sample car showed itself to be a flat failure. The difference between the moduli of elasticity of wood and steel is so marked that it is impossible to secure the advantages of the flexibility of the wood and the rigidity of the steel without a better union between the two than bolting together will afford. For strength but the steel can be depended upon—the weight of wood is hence almost useless except as nailing sills.

The whole idea in the use of this double construction, aside from the nailing facilities, was to secure better riding properties than an all-steel construction would give. It is now known that the all-steel car rides as well if not better than the wooden ones. The combination of two materials into a common beam or column for car underframes is not economically defensible.

EVOLUTION OF FORM III.

The fact that this type of underframe is now so universal in wooden equipment makes its evolution of interest. The interest centers particularly about the recognized fact that when it is desired to change a means of force resistance by utilizing a different material it is proper to know how the present form of resistance came to be introduced and see if we would not fundamentally alter the form of resistance from the very beginning.

Then there should also be considered the fact that what is now in existence may not represent what is best from the engineering standpoint. The designer in the days gone by was handicapped by market conditions. He must take what is provided and not expect steel companies to produce according to his idea. Indeed, even now the same holds true, except for a large consumer. Thus the old fallacies are perpetuated.

The larger corporations can secure the sections they desire. This brings up the point of the larger roads taking the initiative and having the smaller roads influenced in details by such action through the M. C. B. Association. The report of the recent committee appointed by that body to consider the question of "Steel Passenger Cars" unfortunately brought but little before the association, but what had been accumulating in the technical magazines since 1903. Historically and as a compilation of such data it is good; otherwise it is too equivocal.

*Copyright, 1908, by Chas. E. Barba.

† See Résumé at the end of this article.

It is noteworthy that they recommended a standard method of end shock measurement—400,000 lbs. at a combined stress of from 12,500 to 15,000 lbs. per sq. in., and for suburban service 20,000 lbs. per sq. in. This figure is much higher than we advocated and is one in which it will be a difficult matter to find a car to stand among the equipment listed in the report.

This recommendation is a great stride in the right direction and it is to be hoped that the next few years will see the three underframe types, particularly the first two, worked out for the service to which they belong and adopted as standard. It would be of as much advantage to produce a method of calculation similarly to that evolved for axles, so as to provide for uniformity in unusual or special cases.

Before 1850 it was unusual to find a car with a platform for side ingress or egress. The customary construction was simply a bumper beam such as is now found in good freight equipment. Where hook and link couplers were used, they were attached by chains directly to the sills, while the link and pin showed a small block of wood for a platform sill. This block was attached to the short center sills. These sills extended back to the bolster, which came in with the introduction of four-wheeled trucks, being the embryo from which the later development came. The necessity for these sills was found in the attachment of the yoke draw bar for the link coupler.

The platform end sill was then originally a short bumper block. Continual bumping shoved the bolster and end sill out of transverse alignment, after which intermediate sills were placed between them. These served to stiffen up the whole end of the car to a marked degree, but even this expedient failed to answer the purpose intended, so that a single longitudinal sill was introduced between bolsters.

The load was thence put upon the bolsters by the two center sills and taken by the single center sill and probably in a small degree by the side sills.

Accidents, however, have shown this to be unsatisfactory, so that the center sill was doubled and made to directly oppose the disjointed center sills on the far side of the bolster. The body end sill was then put out of direct collision by expanding the platform end sill and using the platform for loading.

The intermediate sills were now carried through from the bolster to the body end sill. Thus there were four platform sills with additional draft sills running to the bolster and between the bolsters, the two side and two center sills, so that the introduction of all central sills and platform sills was as an end shock measure and not for load carrying in a vertical plane.

This idea is the basis from which all forms are now worked out, the only difference being in determining what proportion of the vertical load comes upon the center sills.

The destructive action of end shocks next introduced the intermediate sills not as we now have them, but as long diagonals from the body corner post to the center sills at the center of the car.

There is in existence—though not now running—a steel underframe car designed about 20 years ago with these diagonal struts, and no trucks, the journal boxes working in pedestals fastened directly to the underframe.

These diagonal sills were afterwards made to parallel the center and side sills and shorter diagonal struts introduced, dividing the floor of the car into 3 or 4 trussed panel lengths. A type of such an underframe was illustrated in Fig. 2, page 454, December, 1907, issue.

A particularly noteworthy feature of this underframe, which is that of the class "Pa." car of the P. R. R. (1858), is that the car framing between body end sills is a unit and the platform entirely separate. The end load is given to the underframe by separate platform sills.

A half century later the change in the underframe for cars has not been marked to any especial degree. A comparison of this coach run in the days where end shocks and service demands were very small compared with the present, reveals the fallacy of the defense of most of the present underframe systems as reliable and satisfactory.

This car (class Pa.) possessed 230 sq. in. for a short car of about 46 ft. over end sheets. The same road now uses 304 sq. in. in their standard coaches of almost half again the original length. Thus the short car of 50 years ago possessed about ¾ the sill area now provided for the longer cars.

The first class passenger coaches of several prominent Eastern roads provide about 190 sq. in. of sill area. Hence these cars now possess but 4/5 the underframe area given to the P. R. R. coach years ago.

The box cars now possess a wooden underframe of about 280 sq. in. These present a poor showing when in a wreck with the steel freight cars; much more so would the passenger cars with weaker underframes fare under similar conditions.

This form (III) in steel has come into use very gradually. As an instance, the platform became so heavy with its reinforcements that the car framing could not preserve the proper alignment; in repairing old cars for these defects, as well as decayed and broken sills, the wooden stringers were replaced by steel channels or eye beams. This gradually grew into a full steel underframe. Interchangeability argued for the same form in the all-steel equipment and thus the design has been perpetuated notwithstanding it was originally a makeshift. Again the subject has come up, in some cases so suddenly as to permit of little extended investigation as to the possibilities of using steel, so that the older framing was replaced, with but few evident touches, in steel.

The shortness of time available between starting the design and the placing of the order has seriously hampered some designers. The resulting trouble in the shop due to oversight in design has given the subject a black eye on some roads.

It is unfortunate that the managements do not usually foresee the difficulties involved in such a problem, granting at least a year to the designers to evolve a design which will not only be satisfactory for the initial order, but from which future orders of cars of different lengths and character can be constructed most expeditiously.

The research work necessary to determine the possibilities of an all-steel equipment over that of wood is enormous, not only from a manufacturing standpoint, but also in the method of load transference.

There is no doubt in our minds that the labor thus spent is well repaid by the decreased cost of maintenance and interchangeability, so that after the first development any type of car can be designed at short notice with a larger degree of accuracy than has ever before been attempted.

The adoption of the same underframe for the steel as the replaced steel underframe in wooden cars was essentially an economic move, because changes in steel involve considerably more expense than in wood, throughout the design and construction. Accurate information is required; about three times as many drawings go to complete a steel car design as the wooden. All details must be drawn out and dimensioned. The shop must make new dies, templates and jigs, notwithstanding the difficulty involved in reorganizing the shop forces.

There is no reason which can be advanced to justify the use of the form III type of underframe for high speed passenger service over and above that of Forms I and II. Indeed, its use is not only not justified and the advantages claimed for it are more fictitious than real.

For this form to be constructed to secure lightness and economy it must sacrifice strength, which Forms I and II will provide for the same weight. This is especially true for those designs of this form which use intermediate stringers. The intermediate stringer other than the center and side sills are unnecessary and an extravagance. The form is very strong up to the body end sill and bolster, but much weaker in the body of the car, which, of course, is fatal to its use in trains with the other forms. The sills being shallow beams distributed over the floor take uneven loads from the superstructure lading and from any assumed end shock.

These unequal strains cannot even be approximated within

any respectable degree of the correctness of the approximations which can be made for Forms I and II.

All the work of designing a car framing is more or less approximate, in so far as the assumptions for external forces and their shock or strain transference is concerned. This, however, does not mean that it must be very loosely so, although it is in some cases where the framing is disposed so that a mathematical analysis provides nothing of security to rest upon.

The method pursued in one office when designing a steel car to replace a wooden one is to take the area in wood, divide the area and modulus of resistance by 4 and replace by this value in steel. This is so loose it almost falls apart; it might answer in a way were the wooden cars sufficiently reliable, but the balance is the other way since the assumptions upon which the data is obtained are admittedly false.

In the past the proper proportions of the framing members has not been one of calculation whatever; the same sections were used for cars 50, 60, 70 and 80 ft. long, reliance being placed in the truss rods to carry the extra load.

Whatever calculations were made were not as reliable from an engineering standpoint as popular acceptance would seem to indicate. The framing arrangement with the intermediate sills is quite impossible of just analysis, as load transference can be known to take place in so many different ways.

The argument that the end shock used as a basis of design is but an assumption and may vary from 0 to a maximum, is no just cause for laxity in the method used to provide for this basis. This method should be as exact as engineering knowledge will permit else for loose data the possibility is just as great that the error in result will be to combine errors of data and formulæ as it is to neutralize them and make the result almost accurate.

The whole essential thought is centered about the material. An engineer's work involves but few questions when a subject such as the one under discussion is involved—what material, how disposed and what form shall it be used in to meet the requirements?

This was the idea involved in our previous references as to how the engineer can identify himself with his material. The process of underframe design is but to use the best material, so disposed that the strains must be taken as designed and resisted by the most economical sections.

It is possible to design an underframe of any form for any service, but to do so the question of weight and economy must not be neglected. This is the fault with those forms which seek to make the division of the end shock and lading distributed over all sills.

The main point then to be learned from a study of the equipment and the changes involved is that the intermediate sills are not of importance when the underframe is of steel; that truss rods should be omitted and that this weight should be used for side or center sill strengthening.

The great variety in the underframe members noted in the list at the beginning of the article is due in a great measure to the character of the superstructure.

A wooden structure upon steel underframe must have sufficient rigidity to avoid the use of truss rods, which means the side must either extend up from the side sills as a plate girder or be fishbellied below the side sills. When the side plate is used the car is of composite construction. The second makes it but a steel underframe.

This change, using either a side girder or fishbellied side sills, will adapt any of the previous underframe forms to composite or an all-wood superstructure, with the addition of suitable nailing sills. The essential points to remember being that the side girder or truss must be inherently capable of vertical load carrying between supports.

The use of a large steel casting as the underframe for the platform back to and including the bolster does not seem advisable for various reasons. If made of uniform strength, there is a great probability of it breaking in collisions somewhere between the body end sill and bolster and thereby making the repairing not only a difficult task, but also subjected to much waste. Again, it may be so much stronger than the body underframe that a collision would wreck the center of the car before damaging the castings.

The ideal steel casting should at least be double and detachable. One portion acting as the bolster and the end sill, while the other or several others were bolted to it for the platform.

This brings up the question of the congestion of apparatus underneath the platform and means of their support. These are steam heat and air brake pipes, draft gear and buffing arrangement, electrical connectors, coupler release rigging and hand brakes. A suitable casting might be made to simplify the attachment of these accessories.

Drooping Car Ends.

The steel casting which is used for the end sill and bolster or the cast steel bolster itself should have the spacing of the bolster legs a goodly distance apart, as this is a measure destined to avoid the trouble experienced with drooping platform ends.

In reviewing designs of double bolsters of cars covering a period of 25 years the spread of the legs has been found to be about 5′ 0″ and that the distance from the center plate to the body end sill is about 6′ 10″. The support is thus about halfway between end sill and what it would be for a single leg bolster. The single leg bolster should not be used where trouble in alignment of platforms is anticipated.

To obviate the difficulties thus encountered, various expedients have been tried, none of which seem to have relieved the droop. Amongst the most notable of the various forms of reinforcement, for body end sill and platforms, are the use of intermediate platform sills of either I-beam or channel section and running back to the body bolster and even beyond. This form secures strength by excessive weights and is one of the forms known to give trouble by drooping.

The use of steel plates on the inside of letter boards to support the vestibule corner post is another example of present practice, but even this is bad on account of the encroachment of the side entrance doors, when designed for high platforms, in reducing the section area of the plate.

Another form, and one which is prevalent on our heavier equipment, is the use of an inverted truss placed over the bolster, one end of which is tied to the side sill beyond the bolster towards the center of the car, while the other end is used in suspending the intersection of side sill with body end sill, by means of a truss rod.

The introduction of steel equipment is hailed with delight by the shops as a means of relief from these alingment troubles, as with wood they were up to the limit and beyond it, as the increased cost of repairs have proven.

Provisions for Apparatus.

Load carrying conditions being equal, that type of underframe is best which provides the most satisfactory arrangements for the carrying of apparatus underneath the car. This apparatus is now quite complex; there are gas tanks or battery boxes, water tanks, air reservoirs and cylinder, brake gear, water, air, steam and lighting piping, provision boxes and multiple unit control apparatus. These may not be all on one car, but provision must be made for them on an interchangeable underframe.

The fishbellied center and side sills are not the most satisfactory for this reason; heavy apparatus should be as near the center of the car and the trucks as possible. Truss rods interfere; on some cars it has been necessary to use two turnbuckles per truss due to apparatus interference. The side girder with box girder center sills best answers the above requirement.

Strain Transference.

One feature which would prejudice this design in the eyes of a car designer is the inability of forecasting with any good measure of certainty just what course the strains incident to service will follow throughout the framing members.

The center sills always are continuous over platforms, separate draft timbers are secured to these below the platform and run back to the bolster, at about the plane of the top step riser, and intermediate sills are run back from the platform end sill

and likewise terminate at the bolster. This makes a strong platform—very strong; in fact, much stronger than the car between the bolsters. The idea evidently in the mind of the designers of this form of car was that the bolsters should distribute the load put upon them by these sills to the intermediate and side sills, as well as the center sills.

The intermediate sills may act as a fulcrum and the sides get no load whatever, or the sides act as the fulcrum and then they become reaction points and thereby impart loads to the other sills. This case can be summed up as follows:

If the bolster had no deflection in the transverse horizontal plane then the sills would take the load equally or to the limit of their capability; this condition, however, will not hold because in practice the bolsters will defect, the action of which will cause excessive loads being placed upon the center sills with less upon the intermediate and little upon the side sills. If the permissible compression of the center sills is sufficient to permit this condition to hold, then the intermediate sills get their smallest proportion.

With no intermediate sills the condition imposed upon the center sills as far as end shocks is concerned is worse. The matter is one of great doubt throughout.

Fundamentally all car frames must carry their own weights and the relatively small proportion of baggage or personal load; it is just as fundamental a fact that they must be formed to resist end shock. What this end shock may be has been covered in general on page 82, February, 1908.

Thus the provisions which are made for these destructive buffing strains must be capable of standing up to the data secured from a most careful study of the conditions under which the cars will operate, so that an analysis of the suitability of any framing design will hence depend upon the service and type of equipment in use.

This form of car should be used for but that type of service which must needs have the smallest end shock; it is not adapted to as large end shocks for economical building as Form I, much less for Form II. It is adapted to every type of car now running, but when electric service is considered, this is not the car it should be on account of the interference of the truss rods or fishbellied side sills with the apparatus underneath the car.

RESUME.

THE UNDERFRAME PROBLEM.

The data upon which this problem is formulated are in general:

"The demands of the service for which the vehicle is intended and the resistances and destructive forces which it must overcome in such service." (See page 453, Dec., '07, issue.)

The sources from which these data are secured are first the operative and passenger departments. In some cases the items of information are definite and complete, and in others must necessarily be approximated. These items include studies of

(a) Traffic and schedules.
(b) Character of trains.
(c) Number of trains.
(d) Speeds and headway.
(e) Ingress and egress facilities.
(f) Seating capacity.
(g) Length.
(h) Permissible weight.
(i) Maximum cost.
(j) Character of motive power.
(k) Allowable clearances.

Other items may be specified and most probably will be, concerning various detail arrangements which must be incorporated.

The service conditions which produce different demands are those for train and separate unit running. (See p. 455, Dec., '07.)

Under these heads would come the problems associated with the probable change of motive power unit and the strength and reliability factors covering end shocks and vertical lading. (See pp. 455 to 459. The more prominent limitations concerning lightness and economy are found on p. 454.)

ARRANGEMENT OF UNDERFRAME MEMBERS. (p. 461, '07.)

FORM I, PP. 81-83, FEB., 1908.

Load Carrying.—The weight of superstructure and lading is taken by the side girder. Buffing and pulling strains are assumed by the center sills.
Utility—Best for nominal end shocks and cars without central side entrances. Good for multiple unit control (p. 81).
Center Sills—Weak and light—nature of a uniformly loaded continuous beam (p. 83) with end load (p. 84 and p. 153).
Transverse Supports—Nature of a simple beam loaded by center sills both vertically and transversely (p. 156).
Floor Girder—Trussed—Plate—Formed of center sills and side sills in a horizontal plane and used to assist in end shocks (p. 156).
Side Girder—Formed of side sill angles—side plates and belt rail with posts as vertical stiffeners. Loaded from the transverse supports and superstructure (p. 235).

FORM II.

Load Carrying—All loads from superstructure, lading and end shocks taken by the center sills (p. 234).
Utility—The best form for severe service with heavy end shocks; can be used for every type of equipment (p. 235).
Center Sills—Box Girder or Trussed—of the nature of a uniformly loaded overhanging beam with end load (p. 236).
Transverse Cantilevers—Double cantilevers—loaded at each end and supported at the center.
Side Girder—Continuous deck beam of depth between side sills and belt rail loaded with superstructure weight and lading which is transferred to center sills through the transverse cantilevers (p. 238).

FORM III.

Load Carrying—All longitudinal sills carry weight of superstructure and lading. End shocks opposed mainly by the center sills.
Utility—Not adapted to as severe end shocks as Form II for economical building.
Center Sills—Uniformly loaded overhanging beam, subject to end shock.
Intermediate Sills—Uniformly loaded overhanging beams.
Side Sills—Uniformly loaded overhanging beams.
Transverse Supports—Endeavor to equalize load carrying of longitudinal sills.

MELTING SNOW AT FROGS AND SWITCHES.

A new method of snow melting by means of a hydrocarbon fluid was described in a paper presented by J. S. Lang, M. Am. Soc. M. E., at a recent meeting of the Railway Signal Association. The practicability of this method, according to Mr. Lang, has been demonstrated by its use for the purpose of freeing switches from snow and ice during the past three winters at one of the busiest terminals in the country. The process is described as follows:

The melting of the snow or ice is effected by applying to it a flaming fluid of special character, which continued to burn while in the snow, melting and finally evaporating the greater portion of it. On account of the special character of the fluid, the flame is easily maintained regardless of the high winds of the storm or the drifting of the snow.

The fluid is applied by the regular track force by means of a safety distributing can, and the height and extent of the flame can be regulated with ease.

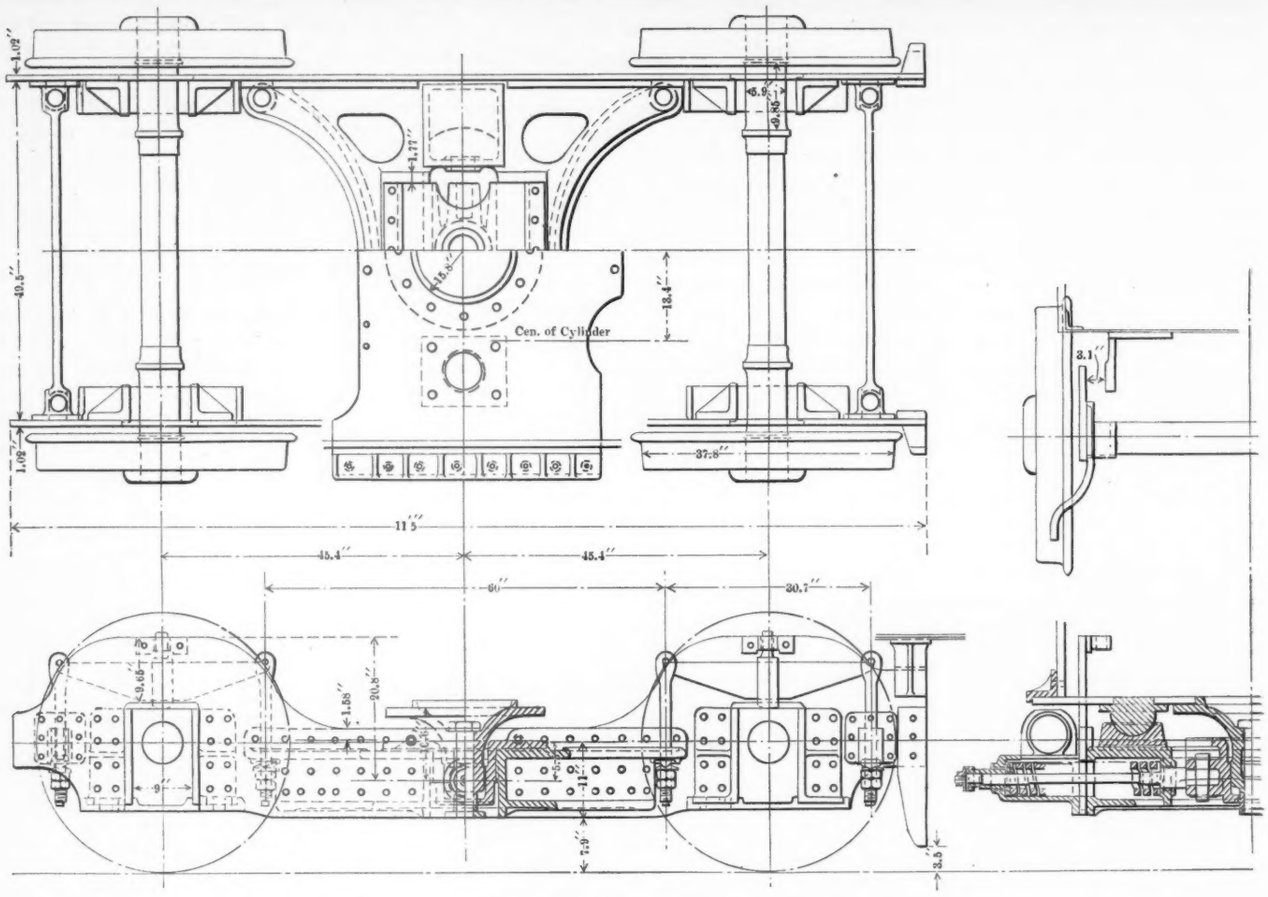
No injury to track results from the use of this system, as the temperature of the rails is not raised to the usual summer heat. The fluid is obtainable in the open market at from three to five cents per gallon and may be obtained free of cost by railroads operating their own Pintsch gas plant.

This system is said to be at once more economical and more effective than the common method of "hand cleaning" switches.

PROPOSED FREIGHT TUNNELS FOR NEW YORK CITY.—W. J. Wilgus, formerly vice-president of the New York Central & Hudson River R. R., and now president of the Amsterdam Corporation, of 165 Broadway, New York, has submitted to the Public Service Commission of that city an extensive plan whereby all the freight, mail, express and waste products of the business section of Manhattan are to be transported through underground railroads, which are to extend from several freight terminals to the basements of the shippers and receivers of merchandise. The plan is somewhat like that of the Chicago subways. The scheme contemplates a vast undertaking and is submitted for public discussion and the commission's approval. Mr. Wilgus states that should the project be approved the Amsterdam Corporation is prepared to submit a proposal by which it may be made effective through the granting of a franchise.

THE CUNARD LINER "LUSITANIA," by her westward voyage, completed July 11, achieved the distinction of being the first 25-knot steamer. She covered the long course from Daunt's Rock to Sandy Hook, of 3,891 miles, in 4 days, 19 hrs., 36 mins., an average speed of 25.01 knots per hour. A new record for the longest day's run was also made, 643 knots having been covered during the first day of the voyage. A readjustment of her propellers, which was made in Liverpool, is considered to have aided the ship to attain this speed. Two new forward propellers of four blades replaced the former three-bladed ones. They are solid castings of manganese bronze. The two rear propellers remain as before, with three blades. It is said that this arrangement also did away with all vibration.

DAILY RAILWAY AND ENGINEERING REVIEW.—During the week of the tenth annual convention of the Railway Engineering and Maintenance of Way Association, and the exhibit of the Road and Track Supply Association in Chicago, beginning March 15, 1909, *The Railway and Engineering Review* will issue a daily paper each morning, except Saturday.



ENGINE TRUCK—DE GLEHN COMPOUND LOCOMOTIVE—PARIS-ORLEANS RAILWAY.

DETAILS OF DEGLEHN COMPOUND LOCOMOTIVE.

Paris-Orleans Railway.

In the September issue of this journal, page 339, is given a general description, with illustrations, of some DeGlehn compound Pacific type locomotives which were recently delivered from the Schenectady Works of the American Locomotive Company to the Paris-Orleans Railway of France. In that article will be found also the drawings and a description of the cylinders and of a very novel design of boiler fitted to these locomotives.

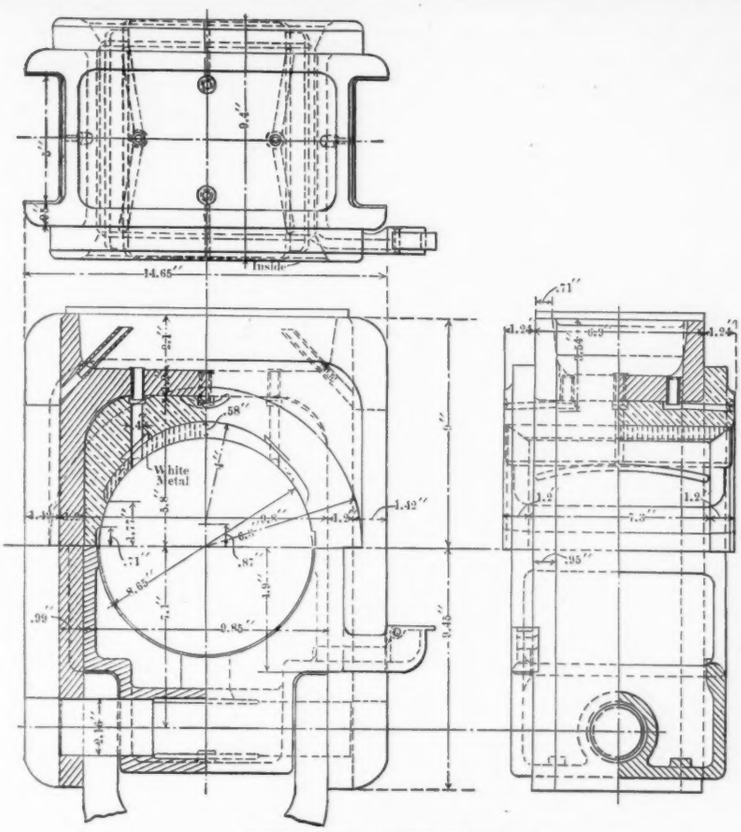
Although these engines were built in American works the design throughout is French and the drawings for use in the shops were dimensioned in the metric system. The drawings were furnished by the railway system and the locomotives are duplicates of a number which have been in service for some time. French locomotive designers have a reputation for painstaking care in details and in many respects their products form examples which American designers could follow to advantage, at least in cases where durability and efficiency are paramount.

Some of the more interesting of the detailed parts of these locomotives are shown in the accompanying illustrations and will be briefly described.

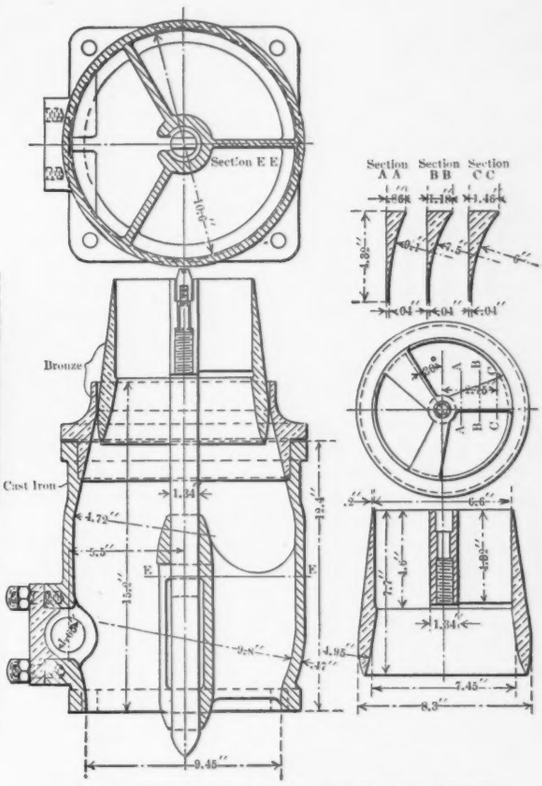
The engine truck is simple in arrangement, but contains features which are not known in American practice. On account of the low pressure cylinders being between the frames it is necessary to have the center bearing very low and the truck consists of side frames of about 1 in. steel and a cast steel center plate, settling well down between the axles, riveted to them. There are also connecting pieces outside of the pedestals for stiffening the side plates. The pedestals are riveted to the plate frames in the same manner as is used on the locomotive main frames. The center pin is secured to a plate fastened beneath the low pressure cylinders and to the locomotive frames and simply acts as a guide, not carrying any of the weight to the truck. This pin sets into a socket which fits in guides in the center plate and is held in position by a spring centering device, the arrangement of which is clearly shown in the illustration. The weight carried by the truck is transferred by two hemispherical bearings, which rest in bearing blocks, sliding upon the center plate. There are four semi-elliptical springs located over the top of the journal boxes and acting independently. At this point it will be noted that the spring is guided by an extension of the top of its center band, which fits into a guide bolted to the side frame. It will also be noted that the spring hangers are fitted with nuts at the bottom and hence the weight can be equalized on the different journals as necessary. The horn extending down in front of the front truck wheel, which is used abroad in place of the pilot, will be noticed in the illustration.

The driving boxes are of interest largely on account of their being constructed of hammered iron instead of cast iron or steel. The illustration shows the construction quite clearly and it will be seen that the brass slips into the box from the bottom and is not pressed in from the side as is the custom in this country. A white metal insert forms the larger part of the bearing area and unusual care has been given to distributing the lubricant both over the journal and to the hub plates and pedestals. The cellar is of cast iron and is held in place by the large bolt which supports the yoke from the springs, the springs being underhung. It will be noted that the cellar is provided with an extension for oiling and that it fits close to the journal on both sides. The driving boxes are casehardened on all bearing surfaces and form a very light and sensible design.

The pistons are interesting largely on account of their lightness, being constructed of hammered steel. Plain square packing rings, which are sprung into place and fitted with dowels to prevent turning, are used. The pistons are screwed on to the rod, having a taper fit. They are heated in boiling water before being fitted to the rod and after they are in place a pin hole is drilled and the pin driven through the head and rod and riveted



DRIVING BOX—PARIS-ORLEANS RY.

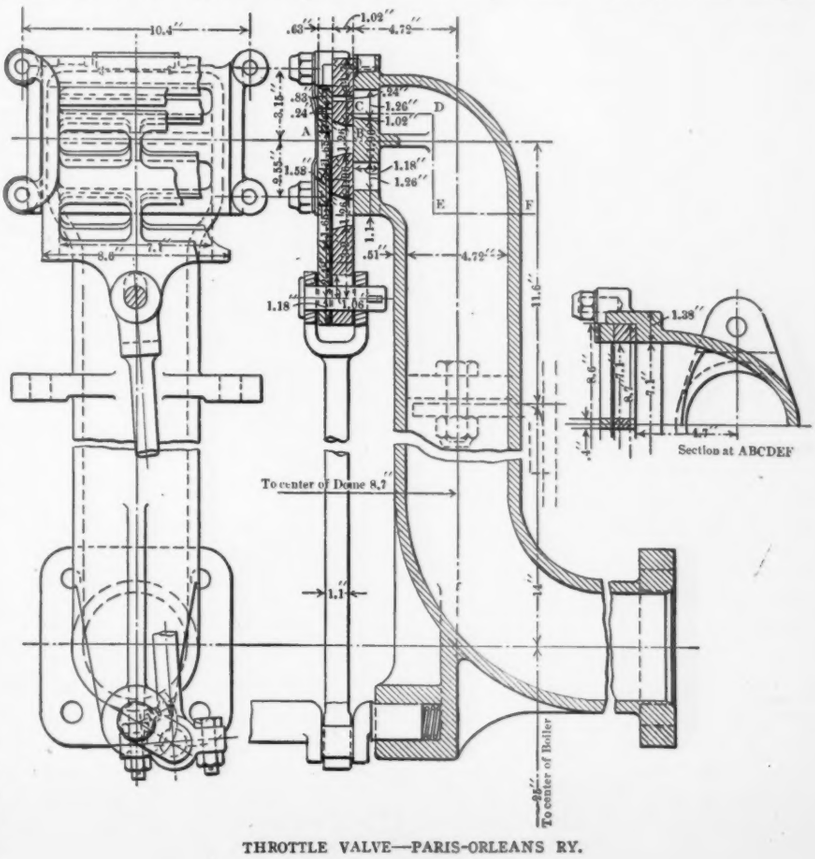


VARIABLE EXHAUST NOZZLE—PARIS-ORLEANS RY.

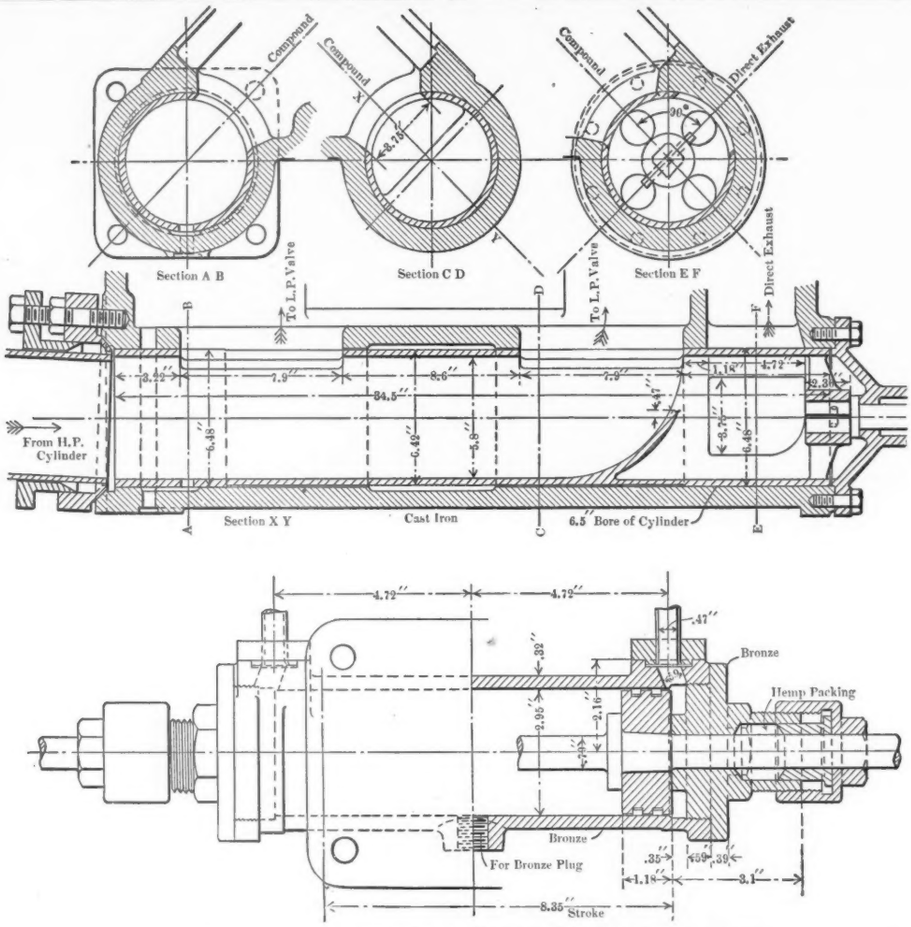
over on both sides. The piston head is about ⅛ of an inch smaller in diameter than the cylinder bore.

The gridiron type of throttle is used on these locomotives, and is shown in one of the illustrations. It requires no particular description and attention is simply called to the supplementary plate on the outside of the main throttle plate and the slotted connection in the latter, which is so arranged that when the throttle is in the position that would normally be called "cracked," only a slit about ¼ in. wide admits steam. Further movement of the lever then throws both plates upward and gradually opens the ports, until finally when in a wide open position two slits measuring about 1¼ x 6¾ in., and giving and area of 17 sq. in., are exposed. The area of the standpipe at this point is but 11.2 sq. in. In closing the throttle the outer or supplementary plate moves first and gradually reduces the opening until the main plate comes into play. These grids are held in place by flat springs arranged as shown in the illustration. The throttle lever is, as mentioned in the description of the locomotive, located on the back head of the boiler and swings in a vertical instead of a horizontal plane. As can be seen, the movement on either side of the center or closed position will open the throttle valve.

The variable type of exhaust nozzle is in very general use on foreign railways, where its design has been very carefully worked out. The exhaust nozzle fitted to these locomotives is shown in one of the illustrations and consists of a bronze tip on a cast iron exhaust pipe within which is a supplementary bronze tip that can be raised and lowered by a connection extending out through the side of the smoke box and having a lever extending to the cab. The movable tip when in its highest position permits the steam to escape only through its center, which is arranged with three vanes and gives the escaping steam a whirling motion. When this tip is lowered, however, an outlet is given around its exterior surface and a cylindrical shaped jet of steam escapes around the inner whirling jet. The farther down the tip is drawn the larger area is given for the escape-



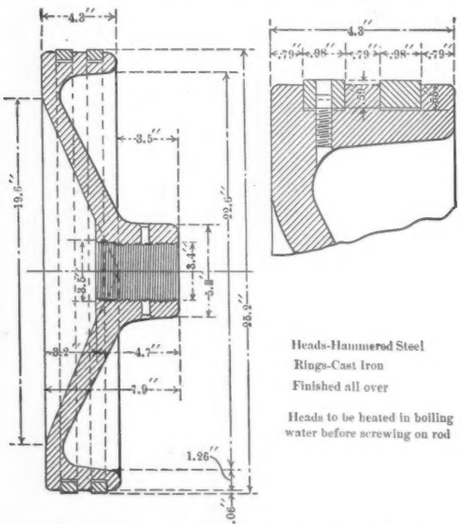
THROTTLE VALVE—PARIS-ORLEANS RY.



INTERCEPTING VALVE AND OPERATING CYLINDER—PARIS-ORLEANS RY.

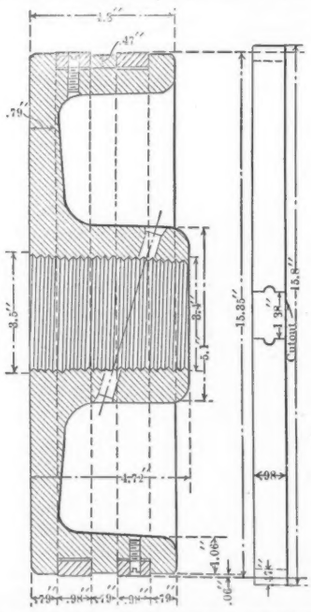
ing of the exhaust. The whirling motion given to the exhaust will permit it to fill a larger stack than it would if straight and also will tend to extinguish sparks by throwing them against the sides as they escape through the stack.

The intercepting valve and its operating cylinder are shown in one of the illustrations. The intercepting valve casing forms a part of the low pressure cylinder casting which extends outside of the main frames and the pipe carrying the exhaust from



LOW PRESSURE PISTON—PARIS-ORLEANS RY.

the high pressure cylinders enters at this point. The valves themselves are rotary, being formed in rights and lefts on the opposite side of the engine and simply consist of hollow cylindrical castings with ports cut at the proper points. They are connected by a shaft and lever arm to the operating cylinder, which sets across the engine just ahead of the low pressure cylinders. The arrangement is such that when it is desired to operate the high or low pressure cylinders alone or to admit reduced pressure live steam to the low pressure cylinders the intercepting valves are rotated through 90 degs. and the port is open which allows the high pressure exhaust to escape directly to the stack through a passage in the low pressure cylinder casting and



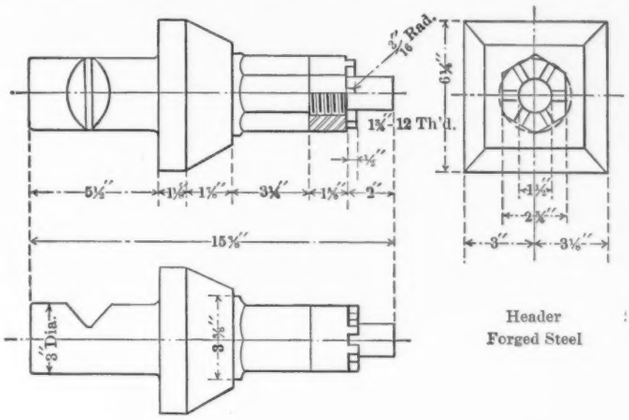
HIGH PRESSURE PISTON—PARIS-ORLEANS RY.

at the same time closes the passage to the low pressure valve chest. In this position the high pressure cylinders can be operated alone, the exhaust escaping as would a simple engine, or if desired, a supplementary valve admitting live steam to the low pressure cylinders, which has no connection to the intercepting valve, can be opened and the low pressure cylinders operated in that manner. The operating cylinder for the inter-

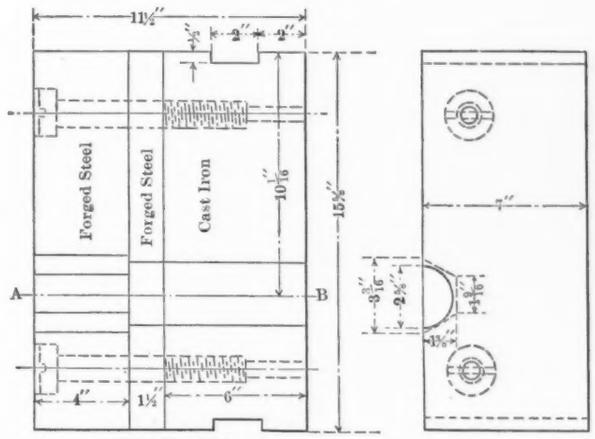
cepting valve, as can be seen, is the most simple design and can be operated by either steam or air through a three-way valve in the cab. Reference should be made to the illustrations showing the low pressure cylinders given on page 341 of the September issue, in this connection.

FORGING CASTLE NUTS.

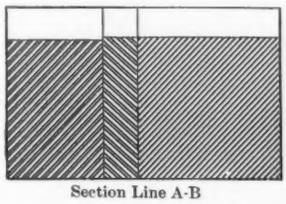
Castle nuts, in sizes ranging from ¾ to 1¾ in., are made at the West Milwaukee shops of the Chicago, Milwaukee & St. Paul Railway on regular forging machines. The ¾ and 1 in. nuts are made on a 2 in. forging machine and the larger ones



Header
Forged Steel



Right Hand Die



Section Line A-B

Note Two Dies,
in rights and lefts

DIES FOR FORGING CASTLE NUTS—C. M. & ST. P. RY.

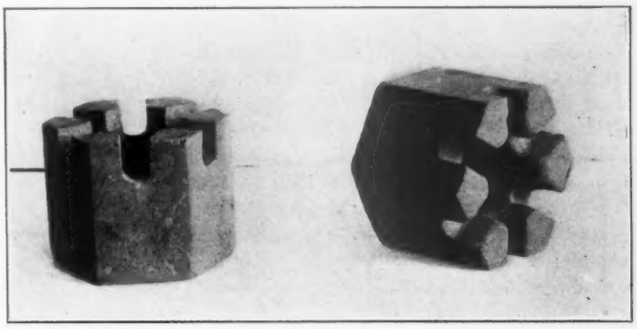
on a 4 in. machine which is equipped with dies and a plunger, as shown in the accompanying illustration. Round bar stock is used, the bar being marked at the proper length to form the nut before being heated and the nut being forged on the end of the long bar, from which it is sheared off as soon as finished by a small shear forming part of the machine.

The nut is formed in one operation. After the two dies close up and hold the bar, the header or plunger comes forward, punching a hole of correct diameter for the tapping of the nut, which extends into the bar one-quarter of an inch beyond the thickness of the nut. The metal thus forced out of the center goes to fill up the hexagon and the extra one-quarter inch beyond the thickness of the nut assures the filling out of the extreme back corners. The header is equipped with bosses which form the slots for the spring cotters. After being sheared off from the stock bar the nut is ready for the tapping machine.

The part of the header which punches the nut and indents the slot is made of hardened tool steel and is arranged so that it can be unscrewed and renewals made at small expense.

At present a 4 in. forging machine is turning out about two hundred 1¾ in. nuts per day of nine hours, smaller nuts being made at a faster rate.

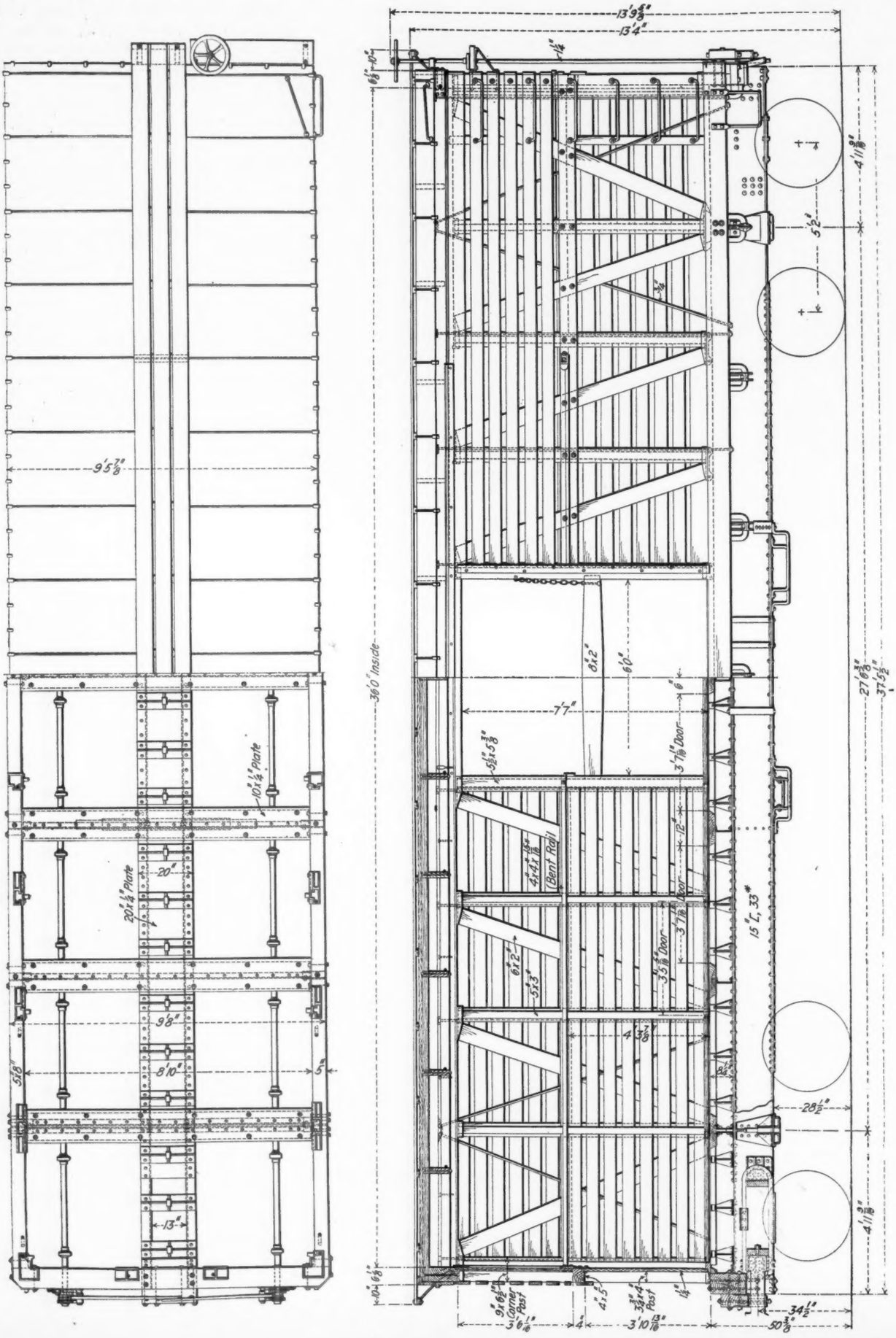
A TRACK SUPPLY EXHIBITION.—The Road and Track Supply Association, which has heretofore made exhibits of track and structural materials and appliances in the parlors of the Auditorium Hotel, Chicago, during the annual convention of the Railway Engineering and Maintenance of Way Association in March of each year, will make its exhibit during the week beginning March 15, 1909, in the Coliseum building. The rooms and facilities in the hotel have been grossly inadequate for the purpose and inconvenient in every way except being in the same building with the convention. The Coliseum on Wabash avenue is especially adapted for exhibitions and is within reasonable distance of the hotel. A large amount of exhibit space has already been sold to manufacturers and dealers, the price being 40 cents per square foot, including booth, signs, etc. The minimum space will be 10 x 10 ft. The usual membership fee of $25 will also be charged, including three badges; extra badges $5 each. Application for space may be addressed to the secretary-treasurer, John N. Reynolds, 160 Harrison street, Chicago.



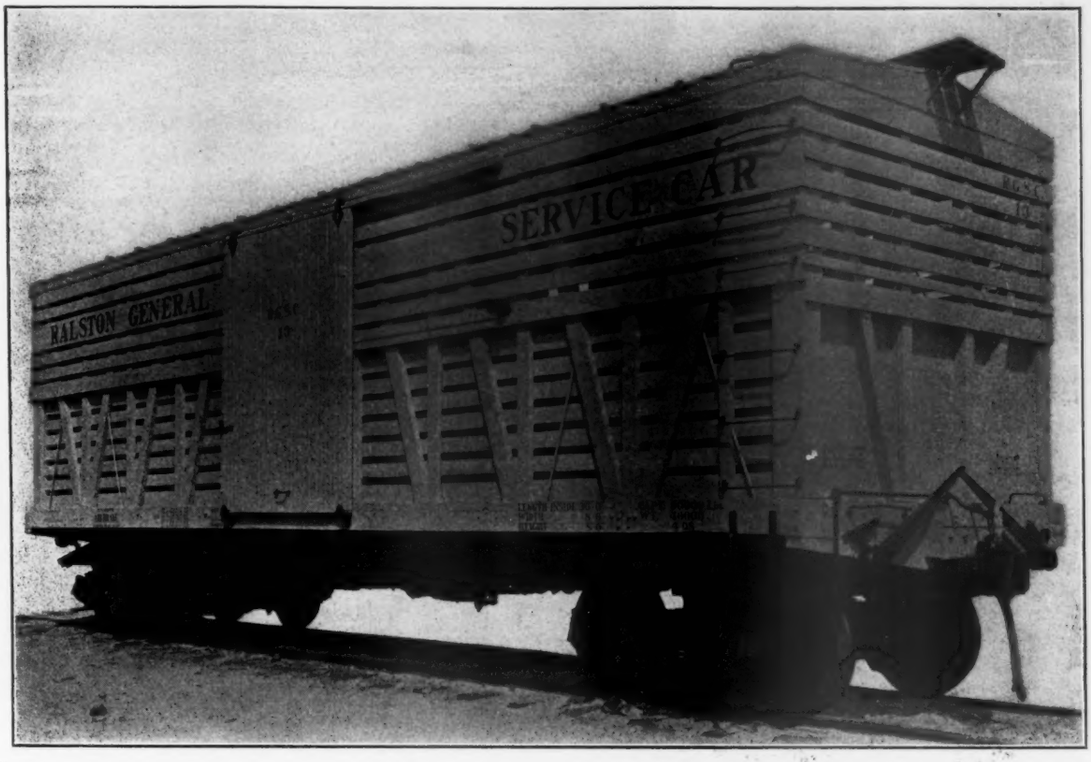
CASTLE NUTS BEFORE TAPPING—C. M. & ST. P. RY.

BRITISH RAILWAY ACCIDENTS IN 1907.—The annual Board of Trade return on railway accidents in the United Kingdom shows that 1,117 persons were killed and 8,811 injured by accidents due to the running of trains. These figures show a decrease of 52 in the number killed and an increase of 1,599 in the number injured, as compared with the totals for the previous year. Eighteen passengers were killed in train accidents, this number being below the average for the previous ten years. Eleven of these fatal accidents occurred in the disaster at Shrewsbury. The number of railway employees killed and injured in train accidents were 13 and 236 respectively; the number killed being the same as in the previous year, while the number injured shows an increase of 96. In the class of accidents caused by the movement of trains, exclusive of train accidents, 102 passengers were killed and 2,132 injured; a decrease of six in the number killed and an increase of 183 in the number injured, compared with 1906. It is remarked that the casualties to passengers in this class are much more numerous than those caused by train accidents, but they differ from the latter in this respect, that they mostly arise from the carelessness of the passengers themselves.

TRACK PRIZES ON THE P. R. R.—In accordance with a custom of long standing cash prizes aggregating $5,400 were awarded October 1 by the Pennsylvania R. R. to supervisors and assistant supervisors for excellence in track maintenance. The prizes range from $600 to $800 for supervisors and from $200 to $400 for the assistant supervisors.



THIRTY-TON GENERAL SERVICE CAR.



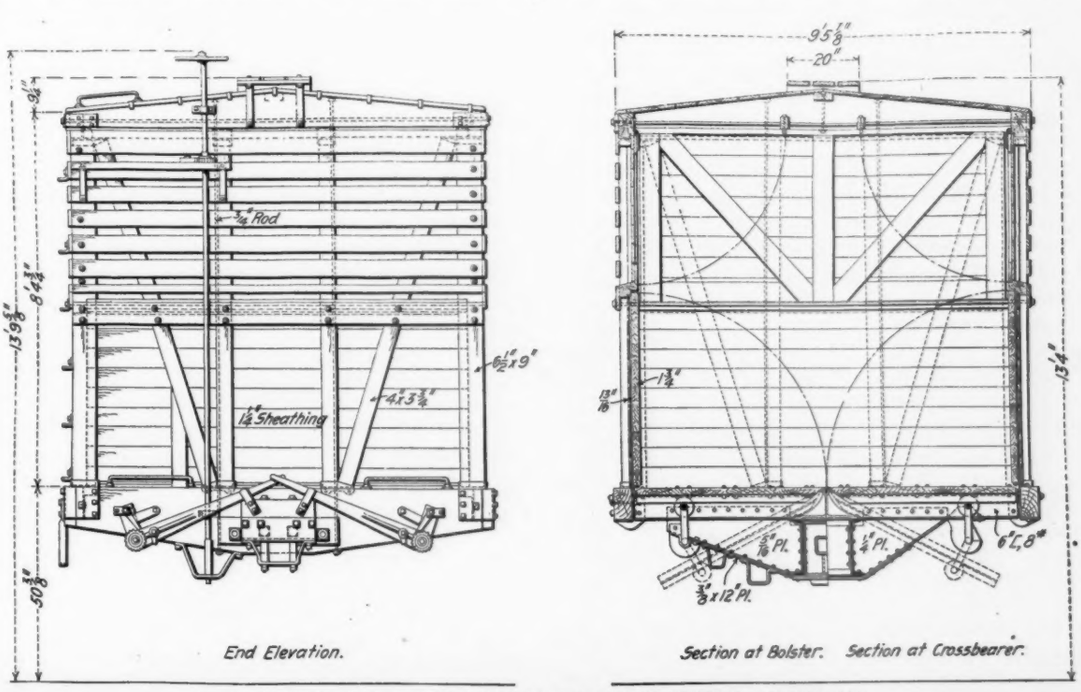
VIEW OF GENERAL SERVICE CAR WITH DROP DOORS RELEASED.

A GENERAL SERVICE FREIGHT EQUIPMENT CAR.

For the purpose of reducing empty car mileage, it is advisable to have freight equipment cars capable of and suitable for handling as many different classes of commodities as possible. The heaviest single kind of traffic, for which it is advisable to have specially adapted equipment on most of the railroads, moves in one direction only and if this equipment cannot be arranged to suit some other commodity for the return trip it must necessarily increase the empty car mileage and be a source of expense instead of revenue for a good portion of its life.

Visitors at the mechanical conventions at Atlantic City last June had an opportunity of inspecting a car which seems to carry the convertible idea to its greatest practical length. This car represents, first, a standard 30-ton stock car and as such does not differ in any essentials from the usual car, as far as the interior arrangement is concerned. It can then be converted into a covered gondola car with tight sides and floors and suitable for conveying any lading usually carried in gondola cars, which would pass through the doors. It can then further be converted into a perfectly tight and satisfactory box car. When arranged in either of the two latter forms it has the further advantage of being a drop bottom car, in which practically the whole of the floor area can be dropped and the lading discharged on either side of the track.

In construction the car is of the composite type, having an



END ELEVATION AND CROSS SECTION OF THIRTY-TON GENERAL SERVICE CAR.

INTERIOR VIEW OF GENERAL SERVICE CAR FOR USE AS GONDOLA.

all-steel underframe and a wooden superstructure including side and end sills. The underframe is constructed so as to take all of the shocks of service and the superstructure is required to carry simply the strains due to shifting loads and its own weight and momentum.

The underframe is of the same general type as is furnished by the builders of this car, the Ralston Steel Car Co., for application under present wooden equipment, or as a foundation for equipment for composite freight cars of any type, and consists of a heavy box girder type of center sill, built up of two 15 in., 33 lb., channels, set 13 in. apart, having a ¼ in. cover plate on top extending the full length of the car and a similar cover plate on the bottom extending nearly to the bolsters. The two channels are notched at either end and the web is bent down, forming a shelf for supporting the wooden end sills of the car. The draft castings are riveted directly to the web of the center sill channels and convey their stresses through a point slightly below the neutral axis of the girder. The construction of the underframe is such as to throw all of the weight of the car, as well as the pulling and buffing stresses, to this center sill, which is evidently of sufficient size and strength to take care of them.

The body bolster consists of four flanged steel plates or diaphragms, 5/16 in. in thickness, riveted to the webs of the center sills and secured at the top to two 6 in., 8 lb., channels extended across the top of the center sill, and forming the tension member of the bolster. A ⅜ in. cover plate, passing underneath the center sills, is riveted to the flanges on the diaphragm plates and to the spacing casting between the center sills. The 6 in. channels carry a hanger casting at either end, in which the 5 x 8 in. wooden side sills are secured. A ¼ in. cover plate on top of the channels completes the bolster construction, which is evidently of more than ordinary strength. The five cross bearers between the bolsters are composed of 6 in., 8 lb., channels resting on top of the center sills in the same manner as at the bolsters. Two of these, near the center of the car, are reinforced by flanged diaphragms riveted to the center sill channels, as is shown in one of the cross sections. The cross bearers have a 10 x ¼ in. cover plate extended the width of the car and forming the floor between the drop doors.

The wooden superstructure is of the usual construction of a standard stock car, as far as the framework is concerned. The floor consists first of sixteen sections, each one forming a drop door, being hinged above the center sills, which, when in a raised position, form a perfectly flat and comparatively tight floor. When used as a stock car there is another floor consisting of 16 sections, which are hinged along the sides above the side sills and are dropped down, matching in the center and forming a perfectly level floor. When it is desired to enclose the lower half of the car for use as a gondola, these sections are raised and fastened along the sides, forming a car which may be used for coal, coke, brick or similar lading. If used as a box car the sections, shown in the illustration as secured under the carlins, are dropped down and, fitting into place, completely enclose the car.

The drop door system is operated by the well-known Ralston type of crank shafts operated by a lever and ratchet at the end of the car. In this case there are four levers, each one operating four doors. When the doors are closed they are held in place by automatic gravity locks, which are positive in their action. These locks carry no strains and are simply to prevent the shaft shaking loose in transit. In addition to the gravity locks at the end there are also locks on the opposite end of the shaft at the center of the car. The arrangement of the drop doors and other operating mechanism is shown in the illustration.

The car weighs 40,000 lbs., is 36 ft. long inside and has a capacity of 60,000 lbs. The side doors can be of any type desired and the trucks are furnished as specified.

SKILL IN HANDLING THE REVERSE LEVER AND THROTTLE gets as many heavy trains in on time as big locomotives carrying a high steam pressure. Skill with the injector counts for as much as skill with the scoop if the steam gauge is any guide.—*C. B. Conger before the Traveling Engineers' Association.*

RAILWAY BUSINESS ASSOCIATION.

An important meeting of the manufacturers of railroad material and equipment was held at the Waldorf-Astoria, New York City, on the evening of September 30 for the purpose of forming a permanent organization whose object should be to obtain united action in systematic efforts for the conservation of the interests of the railroads. The Association, called the "Railroad Business Association," was formally organized and the following officers elected: George A. Post, president; H. H. Westinghouse, O. H. Cutler, W. H. Marshall, E. S. S. Keith, A. H. Mulliken, O. P. Letchworth, vice-presidents; Charles A. Moore, treasurer, and W. P. Pearce, William V. Kelley, Col. H. G. Prout, J. S. Coffin, N. Paul Fenner, E. L. Adreon, J. H. Schwacke, A. M. Kittredge and John F. Deckson, executive committee.

It was thoroughly impressed upon all of those present that this association is strictly non-partisan; it has, and is to have, nothing at all to do with politics. It has no axe to grind other than to see that fair play is given to the railroads. It does not attempt to excuse the misdeeds of railways, but exists for the purpose of attempting to guide and form public opinion so that the railways will be accorded the credit due them from the public and be given a chance to counteract the results of the work of the demagogue and agitator. The reasons for an organization of this kind are best given by some extracts from the address delivered by George A. Post, president of the Standard Coupler Company, who acted as temporary chairman of the meeting. He stated in part:

When railroads are prosperous, times are good everywhere; when railroads are not prosperous, jobless hordes are in despair, and the cupboards of workingmen are bare. Largely responsible for this paralysis afflicting our railroads is the attitude of harsh hostility toward them, as manifested in federal and state administrative and legislative circles. Because of this hostility, confidence of investors in their prospective profitable operations, and in the stability of values of their securities has been seriously undermined.

To denounce railroads and railroad officers, and to scheme for their discomfiture, has become epidemic among many people otherwise rational. So persistent has been the indiscriminate condemnation of railroad managers, that it has come to be considered a necessary ingredient of the vocal output of those who seek popular favor to gain political preferment. In the absence of any other qualification for the exercise of political power, the aspirant has deemed it sufficient to declaim vehemently against railroads and to give assurance that condign punishment shall be meted out by him, if elected, to those who control the means of transportation. No legislative anti-corporation bomb could be too deadly to please people who are frenzied in their opposition thereto.

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To attain the knowledge and experience wherewith properly and successfully to operate a railroad is a tedious process. The preliminary training covers many years of patient toil and profound study of the subject, and is then only possible of attainment by those of a high order of intelligence. And yet, it has come to pass in this era of hysteria that such men and their views regarding railroad operations are tabooed. The popular conception of the true railroad scientist is one who never spent a day of his life in railroad service, but whose mental activities have been applied in other occupations far removed from the possibility of acquiring railroad knowledge. It is a peculiar fact that a trained railroad man will frankly disavow any knowledge of how to conduct any other business, but you seldom find a man running any other kind of business, whether successfully or otherwise, who does not consider himself a competent critic of railroad management.

The railroads of America are just now the victims of a powerful and vindictive wrath trust. We hear much of the depredations of trust magnates, and the injustice and oppressions of predatory wealth. But what of the devastating attacks of "predatory wrath" upon railroads? There has been an amalgamation of all the small local hostilities to railroads that have been started—here through the peevishness of some station agent, there through the brusque manners of an uncivil train man, elsewhere by the avarice of some wicked stock jobber, or, in some quarters, by the frosty pomposity of some railroad executive. These wrath factories have poisoned the minds of whole communities, and sharp-tongued representatives have enlisted the antagonism of counties. Ignited by the fiery objurgation of excited orators, states have become mammoth furnaces wherein discontent has seethed, hissed and blazed. From these fires of wrath, sparks in the shape of ambitious, cunning, self-seekers have been shot into the municipal, county, state and federal councils, there to set fire to the imagination, the hopes, the fears, and cupidity of the populace, and to hurl fire-brands of inimical legislation into the camps of the railroads. Onward has spread the work of consolidation.

* * * * * * * * * * *

It has been a great, fat feast for predatory wrath makers. They have roamed abroad throughout the land, putting crimps in railroads that make them writhe in the agonies of depleted revenues and that have emptied the dinner pails of an army of railroad employees.

No trust that was ever organized in this country has it in its power to create the thousandth part of the havoc, rob so many people of employment, strike terror to the hearts of investors and diminish the incomes of widows and orphans as has this same juggernaut of agitation—the wrath trust.

Its vengeful progress must be checked. The hour has struck when courageous men must form a wall of human adamant and resist it. If ever again good times shall return to bless us; if ever again we may boast of American prosperity; if ever again confidence shall be restored in business circles, there must be an end to this frenzied fulmination against railroads, and calm reason must bear sway in the solution of the intricate problems that confront us.

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In any dispute the right is seldom all on one side. All the zeal for gain and commercial advantage in this country is not confined to those who manage our railroads. Every shipper is not a saint, nor is every common carrier a demon. Not every complaint lodged against a railroad is founded in truth and equity. A large percentage of the hue and cry against railroads is simply the vaporings of chronic growlers, who growl at railroads as they growl at their neighbors, or find fault with their family's expenditures.

It is true beyond a doubt that there have been in the past and are at present many things in the conduct of our railroads that were not and are not right, and against which protest has been and may be rightly made. To deny this would be silly, and would render abortive at their inception any efforts that we might make in behalf of railroads. If we would be influential in our friendship for the railroads, our attitude must not be that of condonation of any wrong, but staunch advocacy of fair play all round. We are manufacturers of railroad materials, not vendors of taffy.

There is serious work to be done. We want orders. We want to see the fires lighted in our furnaces, profits flowing into our coffers, workingmen made glad by the joyous sound of the shop whistles calling them from idleness to work. Not one of these hopes can be realized until railroads are relieved of the incubus of hostile agitation that now halts their successful operation.

It is admitted that some reforms are necessary and desirable in the conduct of railroads, to the end that discontent may be quieted. It is conceded that as public servants, exercising the great powers conferred upon them by the people, intended for the public good, and possessed of franchises of untold value, granted them by legislation, railroads should be subjected to proper regulation and supervision by the people through constituted authority. But there is a vast difference between healthful, sane regulation and vicious strangulation. Not every carping critic is a Solomon; nor is every lawmaker a statesman. Because a law is aimed at a railroad does not necessarily make it right or expedient; it may be wrong and work injustice. Hot-headed legislators enact hot-headed legislation. Statutes conceived in wrath have their fruition in paralyzed commerce. As abaters of the smoke nuisance they have our inventors in that line lashed to the mast.

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The thoroughly trained, capable and honest officials, whose energies and brains are concentrated upon the problem of conducting the business of railroads profitably to their owners and satisfactorily to their patrons, should be upheld and their work appreciated. They are, in fact, the overwhelming majority.

Those railroad officials who vex the public by temperamental failings, who are brusque and inconsiderate in their intercourse with the public, must be brought to realize that they are in fact public servants and not monarchs.

Those who may be guilty of wicked practices, in the administration of railroad properties, should be scourged with the lash of universal scorn and driven from the railroad field.

Those who decry railroads with malicious intent; who would cripple them to gratify personal spleen, or for personal aggrandizement, must be exposed and their power for evil destroyed.

Those who criticize railroad methods intelligently; who have just cause for complaint in their dealings with railroads, must be accorded respectful audience and be listened to with ears anxious for the truth.

Those who depend upon railroads for subsistence, directly or indirectly, must be loyal to their means of support, and quick to resent interference therewith by crafty or turbulent trouble makers.

Railroads must be operated with a fair margin of profit, else they cannot maintain efficiency in equipment, adequately meet increasing demands for terminal facilities and other betterments, nor can they pay good wages to their operatives. In other business enterprises, it is a maxim that prices include a profit. If there are no profits, there is bankruptcy. There is no reason why transportation rates should not be adjusted upon the same basis.

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All these things can be accomplished. They must be accomplished. Who are better equipped than bodies of men such as are here assembled, to aid in their accomplishment?

CAR SHORTAGE ON C. P. R.—In a special report by the president of the Canadian Pacific, he said that during the last six years the company had spent $37,000,000 for locomotives and cars, and yet during the next six weeks there would hardly be enough cars to handle the business offered.